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The WEAR Scale: Development of a measure of the social acceptability of a wearable device

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ABSTRACT

The factors affecting the social acceptability of wearable devices are poorly understood, yet they have a strong influence on whether a new wearable succeeds or fails. Because consumer wearable devices are a recently expanding and distinct form of technology, the literature is limited and existing measures of technology acceptance are insufficient. Factors uniquely affecting wearable devices, as compared to technologies not worn on the body, include manners, moral codes, the symbolic communication of dress, habits of dress, fashion, context of use, form, and aesthetics. Therefore, a new measure must be developed to understand the factors affecting the social acceptability of wearable devices and to predict acceptance.

The objective of this research was to use established scale development methodology to develop the WEAR (WEarable Acceptability Range) Scale, a measure of wearable acceptability that can be used with regard to any wearable device. The first step was to determine what is being measured by defining the construct "social acceptability of a wearable" using the literature and interviews of the intended population (Study 1). Next, the WEAR Scale's initial item pool was composed, then reviewed by experts in Study 2. The resulting scale was administered to sample respondents along with similar scales and items for validation purposes. In Study 3, 221 participants responded to the items in response to a Bluetooth Headset. In Study 4, 306 participants responded to the items in response to Apple Watch and Google Glass.

Factor analysis of Study 3 and Study 4 data resulted in a two-factor, fourteen-item solution (WEAR v.3) that was consistent among the three datasets. WEAR v.3 demonstrated good reliability across the three datasets, with alpha ranging from 0.79 to 0.88, and split-half reliability ranging from 0.81 to 0.88. Construct validity was demonstrated by significant correlations between the WEAR Scale and related constructs such as affinity for technology, likeableness ratings, and adoption of technology. The methodical and thorough development process provides a strong argument for content validity. The resulting WEAR Scale identifies two unique dimensions of wearable social acceptability, providing surprising and valuable information for many uses by both academia and industry, including predictive modeling, theory-building, and wearable development and applications.

CHAPTER 1

INTRODUCTION

A variety of wearable devices (or "wearables") have come to market over the decades and the vast majority have been met with commercial failure (Ryan, 2014). What factors affected these products' trajectory, and how could the success or failure of a wearable product be predicted? Chapter 1 provides an overview of the significance of wearable devices and details the objective of this research, which is to describe and explain factors affecting the social acceptability of a wearable device and develop a measure thereof – the WEAR (WEarable Acceptability Range) Scale. This is followed by a definition of the main terms, "wearable" and "social acceptability." Chapter 1 concludes with a detailed explanation of how the WEAR Scale will serve as a measure of an individual's perceptions of the social acceptability of a given wearable.

1.1 Significance and Objective

A new world of wearables is on the horizon, but it will only arrive if people consent to wearing them (Wasik, 2014). While the wearable computing field is in its youth and new ideas abound, a successful path to market and mass adoption is difficult to navigate (Narayanaswami & Raghunath, 2002). Prior to wide adoption, a wearable must first find social acceptance. Such social acceptance is a crucial factor for wearables (as compared to other technologies) because they are worn on the body, in public. The problem in developing wearables and their commercial applications is that these technologies intersect with manners, moral codes, the symbolic communication of dress, habits of dress, fashion, context of use, form, and aesthetics. Social issues in wearable development cannot be ignored (Edwards, 2003). Dunne, Profita, Zeagler, Clawson, Gilliland, Do, and Budd (2014) termed this increasingly important issue “social wearability” and noted that this aspect of wearability has been less explored than the physical and psychological aspects. An instrument for measuring wearable social acceptability is needed to understand the factors affecting not only whether people will consider wearing a device themselves, but also whether they will consider it acceptable for others’ use.

How individuals perceive each other and themselves is affected by society’s increasing use of and reliance on technology (Lum, Sims, Chin, & Lagattuta, 2009). Even though we are a technology-driven society, persons wearing technology may be perceived as less human-like, and there has been and continues to be a negative stigma attached to the excessive use of technology (Lum, Sims, Chin, & Lagattuta, 2009; Manoj & Azariah, 2001). Industry’s lack of understanding of the rapidly evolving landscape of new technology and shifting social norms leads to (at the least) bad press and (at the worst) investigations and lawsuits (Tene & Polonetsky, 2013). Navigating public expectations and regulatory requirements demands tools such as the instrument developed herein.

While challenges exist to incorporating this new world of wearables into existing social norms and culture, such devices offer countless opportunities. Phil Libin, CEO of Evernote (a suite of software and services designed for archiving and notetaking), thinks that wearables will make human beings smarter—more aware, more mindful, less confused, and feeling part of a connected universe (Wasik, 2014). Articulating and delineating such aspirations is important, because technology requires governance; its power is often not balanced by a responsible and humane vision (Fortunati, Katz, & Riccini, 2003). But how do researchers, designers, developers, and engineers proceed from lofty goals to products that really do make our lives better? One necessity is to understand social acceptability and also *lack* of social acceptability. Why do people *not* want certain devices on their own and others' bodies? Industry and academia must tune in to people's concerns about wearing technology and use this feedback as a guide in product development and innovation.

Wearables have the potential to not only make their users smarter and happier, but to save lives. For example, the Embrace wrist-worn device developed at The Massachusetts Institute of Technology (MIT) Media Lab can detect seizures (Dolgin, 2014). It uses changes in skin conductance as an indicator of nervous system abnormalities that often precede epileptic seizures. The Embrace has the potential to warn of an impending attack, text caregivers about the situation to provide emergency response, and collect data to better understand and predict seizures. However, as a constantly-worn object, users' acceptance of the Embrace's look and feel is crucial.

A barrier on the path to wearable acceptability is that wearables are a new aesthetic (Pacifici & Girardi, 2003). As such, they present a unique challenge: to create something beautiful and functional and personal (Wasik, 2014). Wearables will potentially overtake the now-ubiquitous mobile phone. Many users of mobile phones take out their device and enter a passcode upwards of 100 times a day (Wasik, 2014). Wearables, on the other hand, hold the promise of continuous and instantaneous information. We can even produce action before intention with wearables, e.g., Google Now, which is designed to deliver needed information based on context (Google Now, 2015). An application like Google Now would allow users to get directions, or a meeting reminder, before they even know they need the info, from an always-on, worn device (Wasik, 2014).

Wearable devices are now at the center of almost every discussion related to, and are set to become an integral part of, the emerging Internet of Things ("IoT") (Mouser Electronics, 2015; Swan, 2012). The IoT supports the process of connecting real-world objects, including human bodies, to the Internet (Swan, 2012). In other words, everyday things are increasingly coming online with embedded sensors and microprocessors, communicating with each other and the Internet (Swan, 2012). The IoT was the top trend at the 2015 Consumer Electronics Show, an internationally recognized trade show of the technology and electronics industry (Wood, 2015).

According to Swan (2012), the number of devices on the Internet is estimated to reach 50 billion in 2020, with new classes of technical capability and applications being created. Longer term, the IoT could bring a "Cambrian explosion" with regard to the number and types of sensors, hardware, software, and applications, including wearable devices. Eventually, most manufactured matter in the future could have integrated sensors and microprocessors, making the IoT label a redundant and unnecessary demarcation. Swan (2012) identified four critical functional steps in the IoT ecosystem—data creation, information generation, meaning-making, and action-taking—and set a research agenda that included wearable electronics. Indeed, wearables are a near-term, major application area of the IoT with great potential.

However, for this new world of wearable devices and Internet of Things to reach its potential—for users to adopt a particular wearable—people must first deem the device acceptable for themselves and others to wear. Acceptability research is the investigation of the perceived attributes of an ideal innovation, and is used to guide research and development so as to create such an innovation (Rogers, 2003). Rogers (2003) emphasized that efforts should be focused on developing innovations that will be accepted by potential adopters. Thus, a valid and reliable measure such as the WEAR Scale would be a critical tool for researchers and developers.

The capability to measure the social acceptability of an existing wearable, or a prototype, would be highly useful not only for practical applications but also in theory development. User interfaces for wearable computers are inherently different from stationary desktop interfaces as well as mobile computer interfaces, and therefore need their own design and evaluation processes and rationales (Herzog & Witt, 2009). Narayanaswami and Raghunath (2002) articulated five steps from vision to product for wearable computing: vision articulation; vision embodiment; demonstrable prototype; business case; and finally marketable product. At each stage of this product development process, an important benefit to researchers and developers alike would be: 1) empirically-derived principles explaining the social acceptability of wearables; and 2) a valid and reliable instrument to measure a certain prototype's or product's social acceptability according to consumers' perceptions. This dissertation thus addresses these gaps in research and practice by delivering these principles and measurement instrument.

The research herein also contributes to the disciplines of human computer interaction and social science in that wearables (unlike other computing devices) are about the body and the self. Wearable electronics are changing the way we communicate and use clothes (Worsley, 2011). They are about the integration of the human body with technology, which is a topic that generates both anxiety and delight, and that will remain a major social issue for the foreseeable future (Fortunati, Katz, & Riccini, 2003). The use of technology as an extension of the body is lacking systematic exploration (Fortunati, Katz, & Riccini, 2003), and the development of a scale to measure social acceptability of wearables will help address this shortcoming in research.

Indeed, the main research question of this work—*what are the factors affecting social acceptability of a wearable device?*—is sparsely addressed in the current literature. While there are existing measures pertaining to the acceptance and adoption of technology in general, the literature suggests that placing technology on one's body is a significantly different matter than using it as a stand-alone device. Many of the existing measures address only particular contexts and functions, such as the use of software in a work situation, which deviate quite critically from wearing a device for personal use. Therefore, while one would expect a positive correlation between measures such as affinity for technology and the acceptability of a wearable, the two are likely separate constructs.

Since there is no existing measure of the social acceptability of a wearable, the main objective of this research is to develop a measure of the construct "social acceptability of a wearable device." This measure, the Wearable Acceptability Range or WEAR Scale, will be a function of both individual differences and the characteristics of a given wearable device. Individual differences (as a person responds uniquely to express attitudes) and the various characteristics of a given wearable device influence a person's attitude of acceptability toward the device. Because valid conclusions are derived from strong and accurate measurement (DeVellis, 2012), this dissertation is dedicated to implementing established methodologies to develop a valid and reliable WEAR Scale.

1.2 Developing a Valid and Reliable Scale

DeVellis (2012) set forth eight steps as a set of guidelines for developing a measurement scale. These steps are provided on the left side of Table 1, with an added ninth step (inferred by DeVellis and stated explicitly here) to test the construct validity. The right side of Table 1 explicates how this methodology was implemented in the development of the WEAR Scale.

Table 1.

Scale Development Methodology and WEAR Scale Process

Scale Development Methodology (DeVellis, 2012)	WEAR Scale Process
1. Determine what is being measured.	Conducted literature review and Study 1: Interviews with 18 questions (*n* = 9).
2. Compose item pool.	Generated items from above data.
3. Determine scale format.	Result was initial item pool (v.1).
4. Expert review of initial item pool.	Conducted Study 2: Expert review (*n* = 3); result was revised item pool (v.2).
5. Determine items or scales for testing construct validity.	Selected items or scales, e.g., Affinity for Technology Scale (Edison & Geissler, 2003), for use in Step 9.
6. Administer items to sample of respondents.	Conducted Study 3: administered item pool (v.2.1) and validation scales/items (*n* = 221) using Bluetooth headset as stimulus. Conducted Study 4: administer item pool (v.2.1) and validation scales/items (*n* = 306) using Apple Watch and Google Glass as stimuli.
7. Evaluate the items.	Conducted initial assessment and exploratory factor analysis on item pool (v.2.1) for each of three stimuli.
8. Adjust scale length.	Used Cronbach's alpha and Spearman-Brown formula to address reliability. Result was WEAR scale (v.3).
9. Test construct validity per Step 5.	Assessed construct validity by comparing WEAR Scale (v.3) with related scales.

First, a comprehensive literature review was conducted to provide concepts for item generation, as well as suggest questions for the interview study. The results of the literature review and the interview study were used to define the construct and compose the item pool. The composition of the item pool and determining the scale format (DeVellis's Steps 2 and 3) were conducted in conjunction with each other. This initial item pool (v.1) was then subjected to expert review, while similar items and scales were selected to assess construct validity. The expert review resulted in the revised item pool (v.2), which was piloted, resulting in v.2.1. This was administered with the validation items/scales to a sample of respondents in the third study using a Bluetooth headset as the wearable. A fourth study was conducted to test two additional wearables (Apple Watch and Google Glass) and to test additional validation items. Lastly, using the results of the third and fourth study, the items were evaluated, the scale length was adjusted, and the validity of the final scale (v.3) was tested.

1.3 Definition of Main Terms

Steve Mann (2014), a renowned researcher and inventor in wearable computing, defined wearable computing as "the study or practice of inventing, designing, building, or using miniature body-borne computational and sensory devices." Wearable computers then may be clothing, or may be worn under, over, or in clothing. Mann stated that he "often uses the term 'Body-Borne Computing' or 'Bearable Computing' as a substitute for 'Wearable Computing' so as to include all manner of technology that is on or in the body, e.g., implantable devices as well as portable devices like smartphones." He noted that the word "portable" is from the French word "porter," which means "to wear." *Wearable Devices*, an online magazine that calls itself the authority on wearable devices, stated that "the terms 'wearable technology,' 'wearable devices,' and 'wearables' all refer to electronic technologies or computers that are incorporated into items of clothing and accessories which can comfortably be worn on the body" (Introduction to wearable technology, 2014).

For the purposes of this research, however, "wearable" or "wearable device" will be used to refer to a computer or electronic device that is worn on the body. Because this research addresses wearables that are visible, the term as used here *excludes* digital clothing (in the sense of fabric) or devices inside or under clothing. The wearables of concern here are personal and personally owned as opposed to being provided by an employer as a work tool (for example); they are purchased and donned at will by the wearer. They are meant to be worn for the greater part of the day, rather than worn occasionally for a specific purpose, like a game controller. Wearables in this research are therefore closely aligned with accessories, like jewelry and sunglasses, but also have commonalities with clothing, and eyeglasses to correct vision, as well as mobile phones. Wearables serve a function but are also meant to be seen—and seen in—and they therefore communicate something about the wearer's identity. Wearable devices addressed by this research are identifiable as technology and therefore are not hidden, for example, in a necklace or motorcycle helmet.

Examples of the devices that fall under this definition are wearable hardware sensor platforms such as wristband sensors, smartwatches, disposable patches, EEG (electroencephalogram) rigs, smartphones, and smartphone peripherals (Swan, 2012). Some wearable technologies have forms very similar to worn objects that have been an accepted part of Western culture for decades, such as wristwatches, or for centuries, such as eyeglasses. Other technologies, such as smartphones, have been recently assimilated into our daily lives, yet are generally not attached to the body. Novel wearable technologies are on the horizon, such as the EEG rig. If the EEG rig were designed to be sufficiently comfortable, unobtrusive, and visually attractive, it could be worn around the clock to continuously collect data and package the data into useful real-time applications (Swan, 2012). Some wearables are not mass-made but are instead DIY projects emanating from the maker movement (The maker movement, 2014), e.g., Adafruit Industries' "Wearable Electronics on Wednesdays" Youtube channel (Adafruit Industries, 2015).

While the idea of intellect augmentation reaches back at least five decades (Engelbart, 1962), software-based augmentation is just now becoming within reach as computers become both wearable and socially acceptable (Xia & Maes, 2013). These developments bring us closer to Steve Mann's vision of wearable computing as a tool for *humanistic intelligence*, which "arises when a human is part of the feedback loop of a computational process in which the human and computer are inextricably intertwined" (Mann, 2001, p. 10).

The "wearability" of wearable devices, according to Dunne et al. (2014, p. 4159), "addresses the factors that affect the degree of comfort the wearer experiences while wearing a device, including physical, psychological, and social aspects." While the physical and psychological aspects of wearability have been well-explored, Dunne et al. expanded that traditional delineation to also encompass the wearer's social identity, social experience, and level of comfort with regard to the device. The scale being developed herein focuses on social aspects, and specifically social acceptability, and this variable is expected to also be influenced by the physical and psychological aspects of wearability.

Defining "social acceptability" requires first understanding its connection to human activity. Putting something on one's body, including a technological device, is an action.

Such an action falls somewhere on a continuum of social acceptability. A person will make decisions about the social acceptability of such an action by using existing knowledge and gathering information about current surroundings (Goffman, 1990). Actions may then be carried out (such as wearing a device), with observers' reactions serving as feedback on the social acceptability of the action (Goffman, 1990). Putting on a wearable can be viewed as a performance, "an intentional action executed by an individual with the awareness of spectators" (Rico & Brewster, 2010, p. 888). The social acceptability of a worn object, then, is driven by a combination of many factors, such as embarrassment, politeness, appearance, social status, context, age, gender, and culture (Goffman, 1990; Lum, Sims, Chin, & Lagattuta, 2009). However, the limited existing literature has focused on the acceptance of gestures that are used to interact with devices (Dunne et al. 2014; Profita et al., 2013; Rico & Brewster, 2010).

These definitions of wearable devices and social acceptability are the building blocks of *defining the construct* that the WEAR Scale will measure, which will occur after considering the body of literature and data from the interview study. However, a few words to clarify the conceptualization of the construct follow.

To summarize, the main goal in developing a scale is to create a valid measure of the underlying construct, which requires a clear conceptualization of the target construct (Clark & Watson, 1995). The construct being measured is social acceptability of a wearable device. Because there is so much variability in such devices, and because both the devices themselves and attitudes toward them are rapidly evolving, such a measure must be made in reference to a given device. Therefore, what is being measured is how acceptable an individual finds a particular device. However, over time data collected across individuals and devices will then result in principles, and perhaps a more general theory, explaining the social acceptability of wearables.

The development of this measure has certain similarities to the development of a measure of presence in virtual environments. Witmer and Singer (1998) believed that the strength of presence experienced in a virtual environment varies as a function of (1) individual differences and (2) the characteristics of the virtual environment. Similarly, this measure is a function of both human individual differences and the product features of a given wearable, and thus should assess these individual differences as well as people's *perceptions* of the characteristics of the device that may affect acceptability.

While most measures of latent social-psychological constructs require respondents to rate perceptions of themselves (e.g., loneliness, self-efficacy) (Netemeyer, Bearden, & Sharma, 2003), there are some such measures that require respondents to rate perceptions of a certain stimulus (as with the WEAR Scale). Such measures typically exist in the marketing literature, and one such example is the development of a scale to measure perceived corporate credibility of specific corporations (Newell & Goldsmith, 2001). Regardless of whether people are rating perceptions of themselves, or a corporation, or a wearable, it is the person (not the object) that is being measured (Netemeyer, Bearden, & Sharma, 2003). The WEAR Scale is thus measuring people's perceptions of a given wearable.

Motivated by gaps in knowledge and research about the factors affecting the social acceptability of wearable devices, the objective of this dissertation is to develop a measure of the construct "social acceptability of a wearable device," or WEAR Scale. The development and use of this new measure will significantly increase our understanding of factors affecting acceptability of wearables, contributing meaningfully to both theory and applications.

CHAPTER 2

LITERATURE REVIEW

Chapter 2 covers three main areas of literature important to the development of a scale to measure the social acceptability of a wearable. First is a summary of the relationships among theory, measurement, and scale development, to provide background and explain the process implemented in this research. Second, the literature of existing models and theories pertaining to both wearable technology and social acceptability is presented. This literature spans technology acceptance, technology adoption, appearance, dress, the body, and fashion. Third, a case study provides an in-depth examination of eyewear and Google Glass, to further identify and understand factors that can affect social acceptance or rejection of a worn object. Concepts from the literature are then used to generate items for the WEAR Scale in Chapter 3.

In conducting the literature review for the purpose of item generation, the primary Internet search engine used was Google Scholar. Some searches were also conducted in Google, to capture current news articles, blog posts, or similar content that can serve as a proxy for archival and observational research and data. The initial search terms focused on "acceptability of wearable technology" and thus the primary terms used were: wearable, wearable device, wearable technology, wearable computer, acceptability, acceptance, and social. Related concepts searched were: body, social theories, social implications, location on body, fashion, style, trends, theories of fashion and clothing, symbolic, self, identity, social psychology, appearance, clothing, judgment, impression formation, and physical appearance. Additionally, individual examples of wearables were searched, such as Google Glass, Pebble watch, and smart watch. As relevant papers were identified, those papers' sources were examined and used in the current work, as appropriate. A number of summative articles were also important sources of information, for example, *Dress and human behavior: A review and critique* (Johnson, Yoo, Kim, & Lennon, 2008). From the totality of this review of the literature, the researcher identified concepts that could be useful in construct definition and item generation, and which are presented in Appendix A, *Concepts Form Literature Considered in Item Generation*. These concepts are marked throughout the literature review as: (see Concept No. ___, Appendix A). However, before this literature is presented, an explanation of theory and measurement, and scale development, are addressed.

2.1 Theory and Measurement

DeVellis (2012) stated that it is common for a researcher to seek to quantify a specific phenomenon prior to addressing the main research question. Indeed, making sense of observations often means they need to be quantified in some manner. If existing measurement tools are unavailable or inappropriate, the researcher may be tempted to rely on instruments of questionable suitability or to hastily construct a new one. This is inadvisable, as it results in inaccurate data, and leads to inaccurate conclusions. Therefore, psychometrics is used to develop a scale to quantify a phenomenon, which can then provide insight into the phenomenon itself. Psychometrics is a methodological paradigm developed within the behavioral and social sciences to measure psychological and social phenomena. Developing a scale to measure such phenomena requires both qualitative and quantitative methodologies (e.g., DeWalt, Rithrock, Yount, & Stone, 2007). A scale is a measurement instrument combining items into a composite score, which reflects theoretical variables that require thought on the part of the respondent rather than measurement via direct observation. Such variables are often part of a larger theoretical framework (DeVellis, 2012).

The relationship of theory to measurement in the behavioral and social sciences is not straightforward. According to DeVellis (2012), in the physical sciences, theories tend to be fewer in number and broader in scope than in the social sciences. While the physical sciences generally address well-delineated phenomena, social science handles numerous theoretical models, making measurement a challenge. Social science theories are more numerous and address phenomena much more narrowly. The most important consideration for a social scientist in developing theory is a detailed knowledge of the phenomena being studied. It follows then that understanding theories related to the research question is critical in measurement development. However, the relevance of measurement to theory is dependent on the intent of researcher (DeVellis, 2012).

A measure of social phenomena is sometimes derived from a theory, and such measure development requires understanding the subtleties of the theory (DeVellis, 2012). According to Jaccard and Jacoby (2010), the most popular method in social science research is to start with an a priori theory. The theory is then tested, to confirm or disconfirm it—this is the confirmatory approach to science.

On the other hand, research may commence atheoretically, only later resulting in a theory (DeVellis, 2012). An example of the latter, as provided by DeVellis, is a market researcher who asks parents to list toys they bought for their children, looks for patterns of relationships in this data, and then develops a model of purchasing behavior. While DeVellis did not use the term "grounded theory," this example does in essence describe the qualitative methodology known as grounded theory, which is an alternative to the confirmatory approach. In grounded theory, data are collected by qualitative methods, e.g., observation, archival records, and interviews (Jaccard & Jacoby, 2010). Theory emerges from data, and the data are thus used to evolve a theory, as shown on the left side of Figure 1. The qualitative data in the present research is derived from the literature and interviews, but in other research instances may include, e.g., observation or archival records.

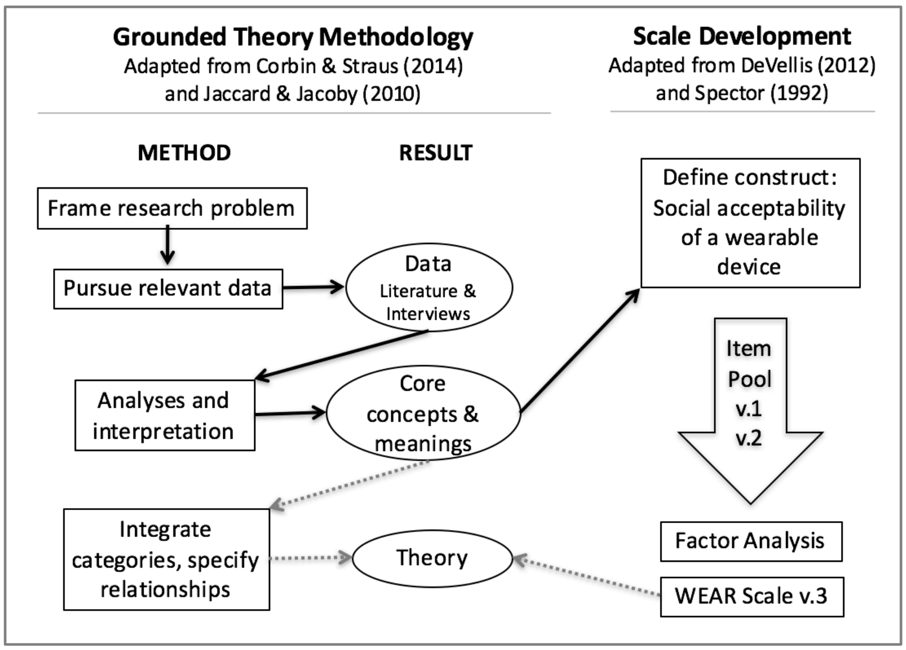


Figure 1. Use of grounded in theory in developing the WEAR Scale (solid arrows).

The literature often associates the confirmatory approach with positivism and the grounded approach to constructivism (Jaccard & Jacoby, 2010). Positivism suggests the existence of an objective reality that can be discerned via the scientific method, while constructivism suggests that such an objective reality is not absolute or truly knowable because humans' perceptions and observations are subjective and fallible. Jaccard and Jacoby advised that this dichotomy is not as concrete as some authors have argued, and that what is important is to use the right tool for the research objective. Scientific methods differ on starting with an a priori theory versus starting with data to construct a theory. The goal is to describe, explain and understand, and ultimately predict phenomena, and to derive the benefits thereof. Either a confirmatory approach or a grounded approach can achieve these ends (Jaccard & Jacoby, 2010).

The goal of this research is to create a new measure. Because there is no existing theory, starting with data (literature and interviews) using grounded theory, rather than an a priori theory, is an obvious methodological choice. While it would seem that using grounded theory to develop a measure would occur with some frequency, the literature is sparse in addressing this situation. In personal communication (May 11, 2015), DeVellis stated that he is not aware of anyone explicitly linking grounded theory and scale development but suspects that it happens. He continued: "Factor analysis is often rooted in qualitative approaches that help the investigator to understand the construct as the population of interest does and then essentially converts that information to a mathematically tractable quantitative form." DeVellis (May 11, 2015) also emphasized the importance of the conceptualization of the variables the scale is intended to assess, and suggested that this is where most researchers are likely to fall short.

One field that has addressed the use of grounded theory in scale development is medicine and nursing (Schreiber & Stern, 2001; Wuest, Hodgins, Merritt-Gray, Seaman, Malcolm, & Furlong, 2006). For example, Schreiber and Stern articulated the advantages of using grounded theory in instrument development. One is that theory development requires careful work comparing main theoretical elements with existing literature, which can be accomplished via grounded theory. Another advantage, in the nursing field, is that grounded theories have provided opportunities to develop clinically useful assessment. Wuest et al. articulated the quandaries of developing and testing a measure derived from grounded theory, concluding that the researcher must respect but not be constrained by the paradigms of traditional science on the one hand and constructivism on the other. This is similar to Jaccard and Jacoby (2010)'s conclusion that confirmatory and emergent (grounded theory) approaches are not conflicting, but complementary.

Grounded theory (Glaser & Strauss, 2009) serves as the basis for qualitative analysis. Originating in the social and behavioral sciences, grounded theory has been widely adopted in the discipline of human computer interaction (Lazar, Feng, & Hochheiser, 2010). Grounded theory is inductive, and thus differs fundamentally from experimental research. Experimental research starts with a hypothesis, which results in a study designed to test the hypothesis, which results in data with which the hypothesis can be rejected, or failed to be rejected, or modified to be tested again. Grounded theory begins with a study which results in data, which leads to theory. The theory thus emerges from (or is grounded in) the data (Lazar, Feng, & Hochheiser, 2010). This approach is consistent with Spector's (1992) strong recommendation to use an inductive (rather than deductive) approach to scale development. An inductive approach begins with a clearly defined construct, which then guides the scale development; in other words, particular instances lead to the more general theory. The relationship between grounded theory methodology and scale development, as discerned by the author, was illustrated in Figure 1.

Both qualitative methods (such as grounded theory) and traditional experimental methods have their strengths and limitations (Lazar, Feng, & Hochheiser, 2010). Grounded theory provides a systematic approach to analyzing the type of data (qualitative, text-based) that is the foundation of a social phenomena, such as acceptability of a worn object. Grounded theory also allows the researcher to study the data up front and engage in constant iteration of theory through data collection and analysis (Lazar, Feng, & Hochheiser, 2010; Myers, 2009). On the other hand, theories developed in this fashion are harder to evaluate and are more prone to be influenced by researcher bias. Qualitative data analysis requires subjective decisions and interpretations of individual observations (Lazar, Feng, & Hochheiser, 2010).

Researchers using grounded theory should strive to set aside any biases and start the research without preconceived theoretical ideas. According to Myers (2009), this is accomplished by being creative and having an open mind. The founders of grounded theory disagree as to whether set procedures are too restrictive (Glaser, 1992) or whether set procedures help make grounded theory more accessible and simpler to implement (Corbin & Strauss, 2014).

In this study, the author endeavored to approach the phenomena with creativity and an open mind, while also generally using guidelines set forth in Corbin and Strauss's (2014) first two of three stages of qualitative data analysis: 1) analyzing a data set pertaining to a substance to identify major components and 2) endeavoring to understand the components in depth, and how they relate. These two steps of qualitative analysis are implemented in the first two steps of DeVellis's scale development methodology as they pertain to the WEAR Scale's development, as shown in Table 1.

Scale development has a rigorous set of guidelines and procedures to test the reliability and validity of a new measure, as discussed in the next section. Additionally, the qualitative data analysis that precedes the writing of the scale's items may be evaluated according to standards of validity and reliability. Lazar, Feng, and Hochheiser (2010) stated that the researcher can best demonstrate validity by showing that her interpretation of the data is firmly grounded in the data. A database or data tables of well-organized raw data, that allows a third party to trace results back to the raw data, forms a chain of evidence (Yin, 2003). The presentation of such data tables in the present research begins in at the conclusion of this chapter with Appendix A, *Concepts from Literature Considered in Item Generation,* and continues through the interviews (Study 1), expert review (Study 2), and administration of scale items (Studies 3 and 4), thus making the development of the grounded data into scale items transparent and self-evident. Such data tables also allow for a reliability check, in that another researcher would be able to duplicate the study (Yin, 2003)—although not necessarily arrive at the same results or theory (Corbin & Strauss, 2014). Data source triangulation (using multiple data sources to support an interpretation or conclusion) is another way to support validity (Stake, 1995), and implemented herein in grounding the data in both the literature and interviews. In some studies, the coding of multiple researchers is compared, with convergence being an argument for reliability. Because a single author is conducting the present studies, this type of intra-coder reliability check is not possible; however, expert review of the item pool provided a similar check on certain types of reliability and validity.

2.2 Scale Development

The main research question of this dissertation is "What are the factors affecting social acceptability of a wearable device?" Quantifying the phenomena of social acceptability with regard to a particular wearable is necessary to fulfill the main research objective. According to DeVellis (2012), ideally measurement tools already exist to quantify the phenomena of interest and answer related research questions. However, sometimes the existing tools are inappropriate and/or unavailable, and their use runs the risk of generating inaccurate data. Development of a measurement instrument in such cases may be the most appropriate path to answering the research question (DeVellis, 2012). As previously discussed, measuring the factors affecting social acceptability of a wearable device requires the development of a new scale.

Why can we not simply ask people, "Is this wearable device socially acceptable to you?" A single yes-no response is insufficient for three primary reasons: reliability, precision, and scope. That is, a single item scale is generally not consistent over time; it places people into only two groups, with no way to distinguish among people in each group; and it is incapable of measuring broad, complex issues (Spector, 1992). Latent constructs require multiple items to most accurately reveal their multi-dimensionality (Netemeyer, Bearden, & Sharma, 2003). Additionally, multiple items provide explanatory details and predictive power.

According to Spector (1992), when little or no conceptual or empirical work has been done on a construct, the construct and scale will probably be developed and evolve together. In such a case, scale development may take several attempts before it is useful. While conceptual or empirical work exists that is related to or is similar to the social acceptability of a wearable device, that exact construct has not been previously defined and measured. Therefore, the work of this dissertation is considered exploratory and foundational; the objective is a strong starting point on which future work (including theory-building) may confidently proceed and, as appropriate, amend and re-evaluate the work herein. The data from this research will suggest a tentative theory of the social acceptability of wearables.

The development of this scale will allow for future research that can use the WEAR Scale to test an a priori theory of the social acceptability of wearables, in a confirmatory approach.

Often the variables of interest to social and behavioral scientists are not directly observable (DeVellis, 2012). Such is the case here, in which the phenomenon being quantified is an individual's attitude, belief, or perception toward a wearable, specifically whether the individual finds it acceptable for people to wear the device. While existing theories relating to technology acceptance measure observable behaviors such as the purchase or use of technology, the acceptance of a wearable precedes (and does not necessarily result in) its purchase or use. Therefore, this is a measurement situation in which a "paper and pencil" scale is the appropriate method, rather than measuring usage or purchasing behavior. Usage or purchasing behavior is not appropriate for the WEAR Scale for two primary reasons: the WEAR Scale is meant to be useful in prototype development, prior to commercial release, and people can deem a wearable to be socially acceptable without the desire to purchase it or wear it themselves.

A scale is a measurement instrument that is a collection of items "combined into a composite score and intended to reveal levels of theoretical variables not readily observable by direct means" (DeVellis, 2012, p. 11). As a variable that is not directly observable and requires thought on the part of the respondent (DeVellis, 2012), social acceptability of a wearable is best assessed by means of a scale.

2.2.1 The latent variable and defining the construct

A latent variable is the construct or underlying phenomena that a scale is intended to capture (DeVellis, 2012). The latent variable in this research is an attitude about the social acceptability of a wearable device. There are two chief features of a latent variable (DeVellis, 2012; Netemeyer, Bearden, & Sharma, 2003). One is that it is not manifest (not directly observable). Secondly, it is variable rather than constant. That is, the latent variable's magnitude (level of acceptability) changes according to the person (e.g., people who like versus dislike technology), place (e.g., work versus home), time (e.g., first appearance on market versus a year later), or any mixture of these and other dimensions (DeVellis, 2012). Thus, as an individual responds to the WEAR Scale, the measure estimates the degree of social acceptability at the time and place of measurement for a particular device.

As with most latent variables, social acceptability of a wearable is a characteristic of the individual who is the source of the data. Therefore, the phenomenon of interest is *users' perceptions* of aspects of the particular wearable device, rather than aspects of the particular wearable device itself. DeVellis (2012, p. 18) provided an apt illustration of this: "if we ask a group of shoppers to evaluate characteristics of a particular store, we are assessing *shoppers' perceptions* [emphasis added] rather than aspects of the store itself (which might be more easily assessed by direct observation)."

A latent variable is the presumed cause of item values (with the scale consisting of numerous such items) (DeVellis, 2012; Pett, Lackey, & Sullivan, 2003). Each item should indicate the strength of the latent variable, resulting in a score that is presumed to be *caused* by the strength of the latent variable for a particular respondent at a particular time. A causal relationship between the latent variable and the measure implies that each item should correlate with each other. Therefore, even though the latent variable is hypothetical and unmeasurable, certain empirical relationships are implied. This "classical" measurement model is adopted in this dissertation, as it has proven very useful for social scientists, and many well-known and highly regarded scales have been developed using “classical” measurement theory (DeVellis, 2012; DeWalt, Rithrock, Yount, & Stone, 2007).

2.2.2 Reliability

A measurement is reliable if it performs in predictable and consistent ways (DeVellis, 2012). Because a scale is intended to represent the actual state of the variable being measured, reliability is a key issue. Any true change in scores should be attributable to a change in the measured variable. Procedures to ensure that the WEAR Scale meets common reliability criteria are described below.

Internal consistency evaluates item interrelatedness (Netemeyer, Bearden, & Sharma, 2003)), and is a type of reliability that describes the extent to which items are highly correlated (DeVellis, 2012). Correlations among items are due to either the items causally affecting each other (less likely) or the items sharing a common cause (more likely). Strong correlations among items imply strong associations between the latent variable and the items. The WEAR Scale, whether unidimensional or multidimensional, will be expected to have items that correlate well with each other, as assessed by Cronbach’s alpha (DeVellis, 2012).

Reliability of a scale may also be assessed by examining correlations between scale scores. If an alternate form or forms of a scale exist, scores for the same respondents can be compared across multiple versions. However, developing multiple versions of a measure is burdensome and rarely used, as versions must strictly conform to assumptions of parallel tests. Moreover, split-half reliability methods can achieve much the same estimations of alternate forms, given that alternate forms are essentially contrived of a single pool of items that have been divided. However, the split-half reliability coefficient has only half the number of items used, so a better estimate of the full scale's reliability is obtained via the Spearman-Brown formula. Therefore, in addition to Cronbach's alpha, the WEAR Scale's reliability will be evaluated using the Spearman-Brown formula (DeVellis, 2012).

Finally, test-retest reliability refers to a scale's temporal stability, the rationale being that a construct's measure should be consistent across separate occasions of measurement (DeVellis, 2012; Netemeyer, Bearden, & Sharma, 2003). However, test-retest correlations are only relevant when the phenomena or construct is assumed stable. As DeVellis (2012) pointed out, this is often not the case. Indeed, with regard to wearables, social acceptability changes over time. It would only make sense to examine test-retest reliability under a quite short time span, and there is no reason to expect an individual's responses to vary in a brief period. However, a future longitudinal study may be fruitful, to examine the characteristics of the phenomena's evolution over time for a particular wearable, within and between individuals.

2.2.3 Validity

According to DeVellis (2012), validity is concerned with whether the variable (the construct of the phenomenon) is the underlying cause of item covariation. For the present scale to be valid, then, it must measure the specific variable of social acceptability of a particular wearable device. Conventionally, validity is inferred from the manner in which the scale was constructed (content validity), the scale's ability to predict specific events (criterion-related validity), and the scale's relationship with the measures of other constructs (construct validity) (DeVellis, 2012). The assessment of each of these three types of validity for the WEAR Scale will be considered in turn.

Achieving appropriate content validity is achieved through the development and testing of a specific set of items so that they sufficiently reflect a domain of content and the original facets of the concept (DeVellis, 2012; Netemeyer, Bearden, & Sharma, 2003). In some cases, the universe of items is known and thus can be sampled. However, in many cases, including the scale developed herein, the universe of items is unknown (DeVellis, 2012). Methods do exist to maximize item appropriateness, such as expert review (Devellis, 2012; Sterba, DeVellis, Lewis, Baucom, Jordan, & DeVellis, 2007), which is Study 2 of this dissertation.

Content validity and the definition of the construct are intimately linked (DeVellis, 2012). Definitions for “social acceptability” and “wearable device” were set forth in the introduction, and will be considered along with the literature and the interview study data to define the construct. The concept underlying the WEAR Scale is distinct from, but related to, other concepts detailed in the literature review, Sections 2.3 through 2.6. In the development of a scale such as the WEAR Scale, an item development study (e.g., interviewing the intended population) as an initial phase of scale development can form the basis of an argument for content validity. DeVellis (2012, pp. 60-61) described the process used by Sterba, DeVellis, Lewis, Baucom, Jordan, and DeVellis (2007) to form the basis for content validity:

> The study aimed at identifying appropriate content from the broader empirical and theoretical literature for possible inclusion in the measure. Although the authors examined content from measures of related constructs… they geared

> their item development to specific features of the construct *as they* [the participants] *had defined it* [emphasis added].

Thus, Sterba et al. (2007)'s item development study included interviews with the intended population to obtain feedback on whether the construct made sense to them, and to gain information on *their* conceptualization of the construct and the language they used to talk about it. Item construction then followed from: these interviews; the literature review; and the conceptual definition of the construct. Similar methods are implemented in the development of the WEAR Scale to achieve content validity.

The second type of validity to be considered is criterion-related (or predictive) validity, which refers to a scale's empirical association with some criterion or supposed "gold standard" (DeVellis, 2012; Netemeyer, Bearden, & Sharma, 2003). More specifically, criterion-related validity is the correlation between a scale measuring a construct and another type of measure of the same construct (Pedhazur & Schmelkin, 2013), e.g., the correlation between SAT scores and college GPA. Because the construct "social acceptability of a wearable device" is (to this author's knowledge) a construct not defined nor measured in the existing literature, establishing criterion-related validity would be difficult. However, future directions following initial WEAR Scale development include, for example, assessing the correlation between the WEAR score and purchasing behavior to assess criterion-related validity.

The third type of validity, construct validity, is the extent to which a measure "behaves" with regard to established measures of other constructs (DeVellis, 2012) and is an assessment of how well a scale actually measures the relevant latent construct (Netemeyer, Bearden, & Sharma, 2003). Spector (1992) was referring largely to construct validity when he described scale validation as occurring within a system of hypothesized relations between the construct the scale is meant to measure and other constructs. This, he said, requires formulating hypotheses about constructs and scales, and testing those hypotheses. In other words, hypotheses are developed about the causes, effects, and correlates of the construct. Once the scale has been devised, it is used to test these hypotheses. Empirical support for the hypotheses allows for tentative acceptance of the construct and validation of the scale. Over time, if the scale is shown to be useful—that is, if the scale can explain and predict the given phenomena—then that is further support of the scale's validity (Spector, 1992). In Chapters 5 and 6, hypotheses about constructs relating to social acceptability of a wearable are formulated, and in Studies 3 and 4 participants respond to measures of these related constructs. If the null hypotheses are rejected, this provides evidence for the construct validity of the WEAR Scale.

From this introduction of measurement and scale development, we now proceed to the literature review that, with the interview study, is the basis for item generation and thus forms an argument for content validity. The literature is detailed in the following sections and consists of three main categories plus a case study: models and theories of technology acceptance and adoption; psychosocial and cognitive theories pertaining to appearance and dress; models and theories of the body, dress, and fashion; and a case study of eyewear as a wearable device. Concepts used in defining the construct, writing interview questions, and generating the scale items are marked as *see Concept No. ___, Appendix A*.

2.3 Models and Theories of Technology Acceptance and Adoption

The first category of literature addressed are theories of technology acceptance, because wearables are a technology. However, it should be noted that the term "acceptance" used in prior research is quite different from the use of the term in developing the WEAR Scale. That is, much acceptance research has occurred in a work-related context in which use is mandatory or encouraged, which is quite different than *choosing* to *wear* a technology for *personal* use. Regardless, the concept of acceptance in the existing body of research described below does offer numerous suggestions for defining the construct "social acceptability of a wearable."

2.3.1 Diffusion of Innovations Theory

An innovation is an idea, practice, or object perceived as new (Rogers, 2003). Rogers's diffusion of innovations theory is one of the oldest and most well-known theories that have been developed in this area. Rogers's theory is used to examine the innovation curves for various innovations, and has been successfully used in many fields, including marketing, communications, public health, and agriculture (Rogers, 2003; Boston University School of Public Health, 2013). Rogers's approach identifies people's psychological traits and personal network configurations that affect the dispersal of a new technology through the social system (Katz & Lazarsfeld, 2009; Rogers, 2003). Rogers's diffusion of innovations theory gives far more attention to adoption ("a decision to use and implement a new idea," Rogers, 2003, p. xix), rather than social acceptability. However, the concepts of acceptance and adoption are linked, in that prior to adoption, an innovation must obtain a certain level of acceptability.

While Rogers identified eight types of diffusion research, the research identified as Type 1 and Type 2 (addressing the earliest stages of diffusion, Rogers, 2003) are most relevant in identifying and measuring the factors affecting the social acceptability of wearables. Type 1 research considers the innovation decision process and Type 2 research considers attributes of innovations and their rate of adoption. Rogers stated that neither Type 1 nor 2 is well-covered in diffusion research. Much prior diffusion research focused on first adopters, who are represented by the beginning of the S-curve, a logistic function that describes the adoption curve. But events and decisions *prior* to adoption have considerable influence and, according to Rogers, should be studied.

2.3.1.1 Type 1 research: The innovation decision process

In what Rogers (2003) called Type 1 diffusion research, *the innovation decision process*, the units of analysis are members of a social system. The independent variables are characteristics of these members, and the main dependent variable is their earliness of knowing about an innovation. Rogers (p. 168) defined the innovation-decision process as the process through which an individual "passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision." Although Rogers does not address social acceptability directly, it is obviously a factor in the early part of this decision process. That is, an individual will come to know about an innovation and may concurrently gain information about its acceptability from a social standpoint, if such information exists. This will influence the individual's attitude toward the innovation. Therefore, initial knowledge about a wearable is a factor affecting acceptability, which consequently affects the formation of attitudes toward the innovation (see Concept No. 44, Appendix A).

According to Rogers (2003), in the knowledge stage of the innovation decision process, a person is exposed to an innovation's existence and gains knowledge of how it functions. This may be a passive process, in that another person presents the innovation, or the potential user may actively initiate knowledge-seeking. People selectively expose themselves to, as well as selectively attend to, stimuli in their environment, like ideas and products. In this way, an individual's interests, needs, and attitudes act as a filter with regard to innovations. While some innovations are created to fulfill a need, it is also true that the existence of an innovation may then create a need for it. This has been true for mobile phones and could certainly be the case for future wearables.

Rogers (2003) identified three types of knowledge about an innovation: awareness that it exists, knowledge of how to use it, and knowledge of how it works. Rogers, however, did not address the social realm. To these three types of knowledge it is reasonable to add a fourth that addresses social impact, and which includes knowledge of social acceptability. The salience of social acceptability, however, depends on the type of innovation. For example, for an agricultural innovation, social acceptability may be a negligible or nonexistent factor, whereas for a birth control innovation, social acceptability may be among the most important variables in the innovation decision process. For a device that is attached to one's person and viewed by others, social acceptability is obviously a critical variable.

Rogers (2003) provided seven generalizations about the type of individual who leans toward early knowledge of an innovation. As compared to later knowers, earlier knowers generally: are more educated; have higher social status; have more exposure to mass media channels; have more exposure to interpersonal channels; have more contact with change agents; have more social participation; and are more cosmopolitan. It should be noted, however, that earlier knowers are not necessarily early adopters. In terms of wearable acceptability, then, early knowers may serve as "gatekeepers" in that they convey opinions of social acceptability to others.

Following the knowledge stage of the innovation decision process is the second stage: the persuasion stage. During the persuasion stage, "the individual forms a favorable or unfavorable attitude toward the innovation. Attitude is a relatively enduring organization of an individual's beliefs about an object that predisposes his or her actions" (Rogers, 2003, p. 174-175). Note that while the previous stage was about knowing, this stage is about feeling. During this stage, a potential user may mentally try out the innovation, and peer communication rather than mass media messages are important. Although a favorable attitude is crucial for adoption, it is not necessarily enough, as often there exists a gap between favorable attitudes and actual adoption (known as the "KAP-gap," for knowledge, attitudes, practice). At the persuasion stage, it is interpersonal channels (rather than mass media channels like at the knowledge stage) that are more likely to cause persuasion effects. Therefore, it is expected that a person's feelings and attitudes about acceptability of a wearable would be more strongly influenced by peers rather than mass media (see Concept No. 45, Appendix A).

The decision stage is the third stage of the innovation decision process, and it leads to adoption or rejection. One way potential users cope with uncertainty is to try out an innovation on a partial basis. Trial by others (peers) can also substitute, to some extent, one's own trial usage. Rogers (2003) pointed out that interested parties may try to speed up the innovation-decision process by sponsoring demonstrations of an innovation, which can be quite effective, especially if the demonstrator is an opinion leader (see Concept No. 40, Appendix A).

Again, wearables are a unique type of innovation, with social acceptability being a particularly salient factor in the decision process given its placement on the body. If a person is unsure about a wearable's social acceptability, will he or she be willing to try it? Wearables may be a special case in which people prefer to wait for their peers to try the innovation and report on the experience—even for early adopters. Finally, who makes a good demonstrator of a wearable? Whereas consumers may be comfortable with a "nerdy" opinion leader explicating the benefits of a personal computer, "nerdy" and "fashionable" are generally not compatible concepts and therefore a wearable demonstrator may be a difficult role to fill (as is further explored in the Study 1 interviews).

The fourth stage of the innovation decision process is implementation of the new idea or product, followed by the fifth and final stage, which is the confirmation of this decision (Rogers, 2003). Presumably, a user will not adopt a wearable unless he or she finds it meets a minimal level of social acceptability. But a wearable, unlike most other innovations, is bound by the rules of fickle fashion. Whereas reaching the confirmation stage often "seals the deal" with most innovations, wearables are a unique innovation in that confirmation may last only as long as one season's fad – another factor affecting their social acceptability.

2.3.1.2 Type 2 research: Attributes of innovations and their rate of adoption

In what Rogers (2003) called Type 2 diffusion research, *attributes of innovations and their rate of adoption*, the units of analysis are the innovations themselves. The independent variables are attributes of innovations (e.g., complexity, compatibility—rather than physical attributes) as perceived by members of a system, and the main dependent variable is rate of adoption. Rogers argued that it makes sense to expand this type of research (such as the research herein) since diffusion of an innovation very much dependent on the innovation itself. Note that the focus is on users' perceptions of the attributes of the innovation, rather than the raw physical characteristics. Per Moore and Benbasat (1991, p. 192), "measuring such perceptions has been termed a 'classic issue' in the innovation diffusion literature, and a key to integrating the various findings of diffusion research." This focus on users' perceptions is based on the fact that even "objective" physical reality is subject to social influences (Tornatzky & Klein, 1982).

Much diffusion research has studied adopter categories—that is, the people adopting the innovation. However, there exists less research on how attributes of innovations affect their rates of adoption. Generalizations about attributes are derived from prior research but can be used to predict the rate of adoption of future innovations. Related research can be valuable in predicting peoples' reactions to an innovation, thus affecting the way an innovation is named and positioned, and how it relates to adopters' beliefs and experiences (Rogers, 2003). Development and use of the WEAR Scale will help address these issues and contribute to the body of Type 2 diffusion research, since the factors affecting their rate of adoption include the factors affecting the social acceptability of that wearable.

Rogers (2003) sought a standard classification scheme that could describe perceived attributes of innovations in universal terms. While no such scheme satisfies this objective exactly, he identified five items that he derived from past writing and research from the past 50 years (e.g., Tornatzky & Klein, 1982), and which he condensed for both generality and concision. These five categories of attributes that affect an innovation's rate of adoption are: relative advantage, compatibility, complexity, trialability, and observability. Rogers found that from 49 to 87 percent of the variance in rate of adoption is determined by these five variables. Below, these variables (or attributes) as identified by Rogers are presented and related to social acceptability of a wearable innovation. Also, a meta-analysis of 75 articles pertaining to ten innovation attributes found that three characteristics—relative advantage, compatibility, and complexity—had the most consistent significant relationships to adoption (Tornatzky & Klein, 1982). Thus, these three attributes of the five that Rogers identified are listed first and deserve particular attention.

Relative Advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. This improvement may, for example, be economic or social. As people make decisions, "they are motivated to seek information in order to decrease uncertainty about the relative advantage of an innovation" (Rogers, 2003, p. 233). This uncertainty reduction process was emphasized by Rogers throughout *Diffusion of Innovations* as critical; indeed, relative advantage is one of the strongest predictors of adoption. The question, however, is whether *Relative Advantage* is relevant to social acceptability. Are wearable innovations that are perceived as an improvement over existing options more socially acceptable? Perhaps, and in particular, if the perceived advantage is *social*, then that should in theory increase social acceptability (see Concept No. 46, Appendix A).

Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (Rogers, 2003) (see Concept No. 41, Appendix A). Technology clusters, such as email and computers, are part of compatibility. Additionally, the name given to an innovation is important in this respect.

Studying people's perceptions of existing ideas in the same category is known as positioning research, and can help identify an appropriate niche for an innovation (Rogers, 2003). Indeed, potential adopters are not blank slates; they perceive a new idea in relation to existing practices. Where applicable, indigenous knowledge systems must be taken into account—the innovation must be compatible with such knowledge systems—even if the relative advantage of a new idea seems obvious (see Concept No. 47, Appendix A). Acceptability research, the "investigation of perceived attributes of an ideal innovation in order to guide R&D so as to create such an innovation," is closely aligned with compatibility (Rogers, 2003, p. 253). Social acceptability of a wearable, then, is closely aligned with the *Compatibility* characteristic.

Complexity is the degree an innovation is perceived as relatively difficult to understand and use (Rogers, 2003) (see Concept No. 42, Appendix A). This can be imagined as a continuum of simplicity-complexity. While the research isn't entirely clear, the generalization is that *Complexity* is negatively related to rate of adoption. Although an innovation's *Complexity* would understandably negatively affect adoption, its effect on social acceptability is unknown, but may also be negative.

Trialability is the degree an innovation can be experimented with on a limited basis. *Trialability* is generally positively related to rate of adoption (see Concept No. 43, Appendix A). This is truer for earlier adopters because they are not able to borrow the innovation from peers. *Trialability* could affect social acceptance, in that it offers an opportunity for people to "get used to" the innovation as part of their social world. For a wearable innovation, other factors include perceptions of the people who are trying out a new device (e.g., are they fashion leaders?) and others' reactions to the device, whether positive or negative.

Trialability, like observability below, has similarities to advertising; however, unlike an advertisement, the manufacturer does not have control of the message. Therefore, *Trialability* and *Observability* may actually cause adoption to decrease when the social feedback is negative, particularly regarding an innovation that is worn on the body.

Observability is the degree that the results of an innovation are visible to others. Overall, *Observability* is positively related to rate of adoption. Generally, then, computer hardware will have a speedier rate of adoption than software because hardware is more visible (Rogers, 2003). As explained earlier, the definition of “wearable” as used in this dissertation is an innovation that is visible. However, it may be that the less obvious a wearable is, the easier it would find social acceptance. Additional factors, such as the wearable’s role in boosting social status, further complicate the effect of *Observability*, which factors are visited in greater detail the next section.

These five attributes (relative advantage, compatibility, complexity, trialability, and observability) first identified by Rogers in 1983 (2003) were used to develop a scale to measure perceptions of adopting an information technology innovation (Moore & Benbasat, 1991). This scale is addressed next, to consider its potential relevance to and usefulness in the development of the WEAR Scale.

2.3.2 Perceptions of adopting an information technology innovation

Moore and Benbasat (1991) developed an instrument to use as a tool in the study of adoption and diffusion of information technologies (IT) within an organization. The scale was designed to measure the various perceptions that an individual may have of adopting an IT innovation. Although this scale pertains to IT use within an organization (not wearables for personal use) and adoption (not acceptance), it is still useful to consider the scale's development and its relation to WEAR Scale development.

Four rounds of sorting by judges, to verify the convergent and discriminant validity of the scales, resulted in grouping the scale items by eight constructs: voluntariness, relative advantage, compatibility, image, ease of use, result demonstrability, visibility, and trialability (Moore & Benbasat, 1991). Voluntariness does not apply to personal wearable use, because all wearable use is voluntary. Ease of use, and demonstrability of results, seem unlikely to affect social acceptability of a wearable (although they would affect adoption). Thus the remaining constructs are four that were also identified by Rogers (2003)—relative advantage, compatibility, observability (i.e., visibility), trialability—as well as a fifth, image.

Image was an additional construct that Moore and Benbasat (1991) identified beyond Rogers' five attributes. They defined image as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Moore & Benbasat, 1991, p. 195). Rogers as well as other researchers considered image to be an aspect of relative advantage (Moore & Benbasat, 1991; Rogers, 1983). Rogers also noted that the desire to gain social status is one of the most important motivations in adopting an innovation advantage. Rogers stated that for some innovations, such as new clothing fashions, the social prestige is almost the sole benefit that the adopter receives; the social value may then disappear as others adopt the same fashion. Rogers (2002, p. 216) asserted that "the adoption of highly visible innovations (for instance, clothing, new cars, and hair styles) is especially likely to be status motivated." To this list, it is reasonable to add wearables. Moore and Benbasat thus added the image construct to their scale, and it will be also considered in WEAR Scale development (see Concept No. 35, Appendix A).

Moore and Benbasat (1991) noted the similarity of the constructs Relative Advantage and Complexity to Davis's (F.D. Davis, 1985) constructs of Perceived Usefulness and Perceived Ease of Use, respectively. Davis's constructs and Technology Acceptance Model are considered next to incorporate their research findings into the development of the WEAR Scale.

2.3.3 Technology Acceptance Model

One of the most well-known models in this area is the Technology Acceptance Model, or TAM (F.D. Davis, 1986; F.D. Davis, 1989). Davis (1989) developed and validated two scales, perceived usefulness and perceived ease of use, which were hypothesized to be the main determinants of "user acceptance" (p. 319) and/or "computer usage" (p. 332-333) (these terms appear to be used interchangeably). An objective was to improve "white collar performance" (p. 319) and provide value to vendors and information systems managers. As hypothesized, both perceived usefulness and perceived ease of use correlated with system use, but only usefulness was strongly linked to usage in regression analysis (see Concept No. 10, Appendix A).

There are numerous problems with attempting to apply the Technology Acceptance Model to the acceptability of a wearable device. The first is that Davis (1989) was not measuring "acceptance" per se, but computer usage in a work setting (a sort of "forced adoption") at a time when most people did not own a home computer and computer interfaces lacked the more mature graphical user interface and user-centered design found currently (Reimer, 2005). People's relationship to technology has undergone great change in the past few decades. Currently most people own multiple devices (PC or laptop for home use, mobile phone, mp3 player, etc.), and usefulness and ease of use are now imperative elements of product design. Secondly, some of the theoretical foundations of the constructs on which Davis (1989) built his scale date to 1970s research on systems utilization and related areas of MIS. Other concepts he used, like self-efficacy theory, cost-benefit paradigm, and adoption of innovations, are relevant to adoption but not necessarily relevant to social acceptance, as the term is employed herein. Whether people find a device generally acceptable for themselves or others to wear may have little to do with its usefulness or ease of use, although it may very well be related to its functions, e.g., surreptitious video recording or viewing messages. For example, the function of a heads-up display has been shown to impair the quality of social interaction (McAtamney & Parker, 2006). A third problem, then, with attempting to apply Davis's model to the current research is that it does not address social factors or influence. Studies and theories subsequent to the Technology Acceptance Model have resulted in numerous competing models. UTAUT (covered next) is one of the most well-known, and most relevant to WEAR Scale development, in that it addresses social factors.

2.3.4 Unified Theory of Acceptance and Use of Technology

Venkatesh, Morris, Davis, and Davis (2003) integrated elements of eight existing models, formulating a model called the Unified Theory of Acceptance and Use of Technology (UTAUT), which does include social factors. Testing provided strong support for UTAUT, which proposed three direct determinants of intention to use (performance expectancy, effort expectancy, and social influence) and two direct determinants of usage behavior (intention and facilitating conditions). One of the models that was incorporated into

UTAUT was Innovation Diffusion Theory (Rogers, 2003), which was reviewed in detail above.

However, as with the Technology Acceptance Model, the UTAUT model was conceived for information technology in an MIS (management information system) context. The model was tested at four organizations among individuals being introduced to a new technology in the workplace. Acceptance referred to intention to use *and* actual use of information technology by employees. Again, this is very different from the concept of being comfortable with others or oneself wearing a technology on the body that is for personal use and results in public viewing. Therefore, while appropriate for the phenomena they studied, TAM and UTAUT are not sufficiently comprehensive to address the factors that affect the social acceptability of wearable technology. The next section widens the literature search to include research conducted in the disciplines of cognitive and social psychology, to further identify and understand the factors of interest, for use in generating items for the WEAR Scale.

2.4 Literature and Theories Pertaining to Dress, the Body/Self, and Fashion

2.4.1 Psychosocial and Cognitive Theories of Dress

Dress can be defined as any purposeful manipulation of the body, including clothing, accessories, cosmetics, hair styling, facial hair, tattooing, and other types of additions done for many purposes, including adornment or grooming (Johnson, Yoo, Kim, & Lennon, 2008). Wearables, therefore, are a form of dress. Dress is the outcome of practices that are put into effect by the individual, and are therefore personal, but are also socially constituted (Entwistle, 2000). As a type of dress, wearable devices have more to do with form factor than with computing (Narayanaswami & Raghunath, 2002). Therefore, theories of dress are more useful than theories of acceptance of technology in developing the WEAR scale.

The dress of an individual affects that person's own behavior as well as the behavior of others; this area of study is the social psychology of dress (Johnson & Lennon, 2014). Our behavior toward another person is influenced by that person's dress (Kaiser, 1997). Clothing, as both an intimate and important piece of one's appearance, is a significant factor in how people relate to one another (L.L. Davis, 1984; Johnson, Yoo, Kim & Lennon, 2008). It may be extrapolated that technology, when placed on the body, similarly becomes a personal object that affects interpersonal behavior and social cognition. Indeed, wearables can be more impactful than clothing in the social realm, in that wearables may interrupt or modify interpersonal communication as well as provide the user with capabilities like video recording (see Concept No. 30, Appendix A).

Theories of dress derive primarily from two disciplines: psychology and sociology. Dress is an interaction of the individual and society, in that it plays a role in the establishment of personal identities (Johnson, Yoo, Kim, & Lennon, 2008), serves as a communication tool with others (Johnson, Yoo, Kim, & Lennon, 2008), and plays a significant role in relationships with others (L.L. Davis, 1984) (see Concepts No. 27 and 28, Appendix A). Some assumptions of research on clothing and human behavior are that: 1) clothing and appearance are a form of communication by the wearer, which results in behavioral or judgmental responses in others; and 2) clothing behavior is a function of the social milieu, personality, and lifestyle of the wearer (L.L. Davis, 1984).

Davis and Lennon (1988), in integrating theoretical and methodological perspectives pertaining to social cognition research with literature from the areas of clothing and human behavior, reported that theory and research from cognitive psychology can be a useful framework for the study of clothing and human behavior. Individuals make judgments about people based on perceptions and cognitive processes. Social cognition focuses on the interaction of cognitive or psychological processes with people (i.e., “social objects”). In general, the term “social cognition” subsumes related terms such as person perception, impression formation, and social perception. Certain theoretical perspectives from cognitive psychology can be applied to clothing and human behavior research, such as social perception theory, attribution theory, impression formation theory, and the process of categorization (Davis & Lennon, 1988). These will be examined in turn and discussed with the goal of identifying factors that affect the social acceptability of wearables, which factors will be used to generate scale items.

Our perceptions are derived from a large amount of complex and ever-changing information (Davis & Lennon, 1988). Social perception theory describes and explains the perceptual processes at work in creating a unified social world from this cacophony of perceptual data. The variables that affect social perception may be categorized as pertaining to: 1) the perceiver; 2) the object or target; and 3) the situation (Davis & Lennon, 1988). Research regarding the influence of perceiver variables on social cognition as it pertains to clothing is limited, but it has been shown that individuals vary in their sensitivity to appearance cues in impression formation (Miller, Feinberg, Davis, & Rowold, 1982; Rowold, 1984). Thus, it is likely that individuals differ in terms of the extent to which they are sensitive to a wearable device as a cue in forming an impression about the wearable user.

Second, in terms of object or target variables, Davis and Lennon (1988) found that the majority of research has been conducted on the effect of clothing styles worn by the stimulus person (or social object) on others' impression formation (e.g., Buckley & Roach, 1974; Conner, Peters, & Nagasawa, 1975; Forsythe, Drake, & Cox, 1984; Hamid, 1968; Hamid, 1969; Nielsen & Kernaleguen, 1976; Pack, 1986). As might be expected, this research has provided overwhelming evidence that variations in the clothing worn by a stimulus person do affect the social impressions made of that person. Similarly, it can be predicted that the presence of a wearable, and the characteristics of the wearable, will affect social impressions made by other people about the user.

Third, situational variables affect social perception. Clothing has been shown to be a form of nonverbal communication, with the message being dependent on the social context (Kaiser, 1997; Damhorst, 1984-85; Rees, Williams, & Giles, 1974). Therefore, it is likely that what a wearable communicates about the user is dependent on the social situation in which it is being used (see Concept No. 7, Appendix A).

Another social cognition theory relevant to dress is attribution theory, which seeks to explain how people assign causes to the behavior of themselves and others (Davis & Lennon, 1988). Perhaps the most salient piece of research, in terms of application to wearables, is the study that found that people believed they had performed better on intelligence tests when wearing eyeglasses as compared to when they did not wear eyeglasses (Kellerman & Laird, 1982). From this it may be predicted that individuals may attribute certain causes or characteristics to the user (whether another person or themselves) based on wearing the device. If certain causes or characteristics have either a positive or negative connotation, then that will affect the wearable's social acceptability (see Concept No. 8, Appendix A). Indeed, people will purposely avoid or reject a product if it is associated with negative symbolic meanings (Banister & Hogg, 2004). A wearable associated with negative connotations, then, would presumably rate low on social acceptability (see Concept No. 2, Appendix A).

Impression formation is another useful theoretical perspective, which deals with how the variety of information that a person presents is fused into a general impression, particularly a first impression (Davis & Lennon, 1988). Asch (1946)'s classic person perception work provided evidence that, using whatever minimal information is available, we attribute traits or characteristics to another person (L.L. Davis, 1984) (see Concept No. 8, Appendix A). If a wearable is part of the minimal information available, then it will impact the viewer's impression of the wearer. Understanding the impact of this first impression, and the factors affecting it, is one of the objectives of the development and use of the WEAR Scale.

Also pertaining to how people make sense of the overwhelming world of information is the concept of "categorization;" that is, we group objects into categories to reduce and organize stimuli (Hamilton, 1979). Thus, we may organize information by focusing on similarities or differences between objects. Clothing researchers have investigated how clothing is categorized by individuals (Butkley, 1984-85; Damhorst, Eckman, & Stout, 1986; Delong, Minshall, & Larntz, 1986). Categorization may be a very important concept in explaining factors affecting wearable acceptability, in that how people categorize a wearable (e.g., as a cell phone or video camera or piece of jewelry) will have an influence. Categorization is related Rogers's (2003) attribute of compatibility (the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters), and positioning research (studying people's perceptions of existing ideas in the same category) (see Concept No. 47, Appendix A).

Similar to the concept of categorization, as explained by Davis and Lennon (1988), is stereotyping in social perception (Taylor, Fiske, Etcoff, & Ruderman, 1978). Stereotyping involves the categorization of individuals into social groups, and much of this research has focused on similarities and differences in the appearance of individuals. It can be inferred, then, that variables that have been shown to be significant in stereotyping, such as race, sex, social status, body type, physical attractiveness, and age, will also play a role in the social acceptability of a wearable, as it appears on a particular person (see Concept No. 52, Appendix A).

Within a social group, a certain range of clothing styles are considered acceptable, and in fact serve to identify individuals as group members as well as reinforce group unity. If a group is attractive to an individual and the individual desires acceptance of the group, then the individual will be motivated to conform to group norms (Deutsch & Gerard, 1955; Festinger, 1954). Thus, if a wearable is accepted and worn by a certain group, individuals who belong or wish to belong to that group will feel pressure to adopt the wearable. On the other hand, individuals not a part of or attracted to said group will be less likely to accept and adopt the wearable, and indeed may actively reject it, if current fellow group members actively reject (see Concept No. 6, Appendix A).

While Byrne's (1971) similarity-attraction research is not specifically related to clothes, it does more broadly explain how an individual perceives others as compared to himself or herself. This approach states that when we perceive others as being similar to ourselves, our own attitudes and behaviors are confirmed, and thus we are more attracted to similar others. Whereas attitudinal similarity is most important, when attitudinal information is not available, people use external cues, including clothing (Buckley & Roach, 1981).

Attraction to others, or lack thereof, affects further interaction (L.L. Davis, 1984). An important factor, then, in an individual's perception and judgment of the acceptability a wearable on another person is whether holistically this other person is perceived as being similar to the viewer. For example, if I perceive you as similar to me, I will be more likely to find your wearable device socially acceptable (than if I perceive you to be dissimilar to me). Nash (1977) found that when two runners passed each other, if they were dressed alike, they tended to engage in an extended conversation, whereas if they were dressed differently, they tended toward a short nonverbal greeting. Thus, we would expect social acceptability ratings of a wearable to be influenced by the wearer's similarity to the viewer (Johnson, Yoo, Kim, & Lennon, 2008) (see Concept No. 4, Appendix A)

Another social variable that affects wearable acceptability is conformity, or group pressure. A person's behavior or attitudes toward clothing can change depending on the behavior or attitudes of one's social group (L.L. Davis, 1984). Venkatesin (1966) found that over half the participants conformed to the group consensus when judging clothing selections (the "best" suit). Davis and Miller (1983) similarly found that group pressure led to conformity with regard to fashion judgments, especially when the judgments were of an ambiguous future fashion. Additionally, experts were more influential than non-experts. Fashion judgments were thus shown to be influenced by situational factors such as judgment ambiguity and reference group. These findings are likely generalizable to judgments about wearables. People may be expected to be more influenced by others' judgment of a wearable if the judgment is ambiguous (e.g., this will be fashionable next year) and pronounced by experts (e.g., people considered both fashion-savvy and tech-savvy).

A person who does *not* conform and dresses inappropriately for his or her culture is "subversive of the most basic social codes and risk[s] exclusion, scorn or ridicule" (Entwistle, 2000, p. 7) (see Concept No. 17, Appendix A). Indeed, this seems foundational or core to the "social acceptability" construct, in that any dress (or donning any object) that results in exclusion, scorn or ridicule makes it unacceptable, and will therefore be a main component of the construct definition. Of course, acceptability goes beyond this basic definition, dependent on many other factors such as individual preferences and context. For example, looking ridiculous on Halloween may be acceptable to some people, or looking "nerdy" may be acceptable at work but not at the gym. However, it is difficult to imagine a situation in which a person would not want to avoid exclusion, scorn or ridicule. If dress results in ridicule, it is not only a personal *faux pas*, but shameful. It is a failure to meet the standards of the present moral order. Dress is therefore closely connected to one's sense of self, and is indeed crucial to defining personal identity (Entwistle, 2000). Fortunati, Katz, and Riccini (2003, p. 6) echoed these sentiments, stating that "one element of the body that must be safeguarded is respect, which is closely connected to the identity of the individual" (see Concept No. 19, Appendix A).

Dress is important not only with regard to acceptability, but also with regard to sociability. Getting dressed is an individual and very personal act, "an act of preparing the body for the social world, making it appropriate, acceptable, indeed respectable and possibly even desirable also" (Entwistle, 2000, p. 7). Most people have had at least one experience of leaving the house wearing clothes that later feel "wrong" compared to what others are wearing. Other mistakes of dress can also be embarrassing (like a zipper undone or a stain on clothes) or even stigmatizing. To feel that one's dress is unacceptable to others is to feel awkward, out of place, and vulnerable. Dress is the inescapable interface between the individual and the social world, where the private and public meet (Entwistle, 2000). A wearable, then, must fit into the user's conception of acceptable dress.

"Enclothed cognition" is another framework that has been put forth to unify many findings at the intersection of social psychology and dress, and describes the systematic influence that clothes have on the wearer's psychological processes (Adam & Galinsky, 2012). Drawing on theories of embodied cognition (e.g., Niedenthal, Barsalou, Winkielman, Krauth-Gruber & Ric, 2005), Adam and Galinsky posited that wearing clothes causes people to embody not just the clothes but also the clothing's symbolic meaning. For example, Adam and Galinsky found in a pretest that a lab coat is generally associated with attentiveness, and in the following experiment found that wearing a lab coat increased selective attention compared to not wearing a lab coat. Their experiments provided initial support that the two independent factors of enclothed cognition—the symbolic meaning of the clothes and the physical experience of wearing them—have significant and systematic psychological and behavioral consequences for their wearers. This supports earlier research such as Kellerman and Laird's (1982) finding that people believed they had performed better on intelligence tests when wearing eyeglasses as compared to when they did not wear eyeglasses. Therefore, a wearable device's symbolic meaning will affect its wearer's "enclothed cognition" and also its social acceptability (see Concept No. 1, Appendix A).

A few studies have specifically examined social perceptions of worn technology. In one, researchers examined viewers' perceptions of others who wear technology, finding that models were overall viewed less favorably when wearing technology (Lum, Sims, Chin, & Lagattuta, 2009). Four categories of technology were modeled in the stimuli photos: a control condition with no equipment; an eye tracking condition (two different models of eye trackers); a consumer technology condition (headphones, Bluetooth ear piece and microphone headset); and a nontechnology condition (military helmet, bicycle helmet, and sunglasses). Participants rated the models as most trustworthy, most friendly, and most intelligent in the control (no equipment) condition. On the other hand, participants rated the models most threatening and most artificial in the Eye Tracker Technology condition (see Concept No. 32, Appendix A). Such results, the authors stated, suggest that individuals may perceive others more positively when they adhere to expectations for what people naturally look like (see Concept No. 33, Appendix A). However, the attributions were a complex interaction of the viewer's comfort with technology, the gender of the model, and the specific attribute under consideration. The authors also concluded that wearables may interfere with interpersonal relations (Lum, Sims, Chin, & Lagattuta, 2009) (see Concept No. 34, Appendix A).

In another study of social perceptions and worn technology, researchers evaluated the impact of a device's bodily location on social acceptability of gesture interaction (Dunne, Profita, Zeagler, Clawson, Gilliland, Do, and Budd, 2014; Profita, Clawson, Gilliland, Zeagler, Starner, Budd, & Do, 2013). The qualitative analysis (2014) found that the wrist and forearm were preferred bodily placements due to reasons of usability and avoiding social discomfort. Participants expressed concerns about less favorable bodily locations for wearables as the desire to avoid feelings of awkwardness or embarrassment (see Concept No. 12, Appendix A). However, both gender and culture were factors in deeming a bodily location as acceptable or not acceptable. The quantitative analysis (2013) suggested that both in the United States and South Korea, the most positive interaction and controller placement ratings were for the wrist and forearm. Additionally, the most important feature for a wearable in the United States was ease of operation, while in South Korea it was minimizing an awkward appearance. Such research findings highlight the caveat that cultural differences will have an impact on both WEAR Scale development (i.e., its development in the Midwestern United States will inevitably influence the Scale) and findings (i.e., WEAR Scale results for a single wearable will likely differ among cultures).

2.4.2 The Body, the Self, and Symbolic Communication

Given that wearables are a form of dress, and dress is defined as a purposeful manipulation of the body (Johnson et al., 2008), understanding social acceptability of wearables must include an examination of the body, the body's relation to the self, and the body's symbolic value. To begin with, some basic facts are that the body is inseparable from self, the body is the environment of the self, and human bodies are dressed bodies (Entwistle, 2000). The body is physically real but not easily physically delimited, and it is a social construct (Fortunati, Katz, & Riccini, 2003). Moreover, getting dressed is a private experience with the body, and results in its public presentation (Entwistle, 2000). What we wear has been called "a natural extension of the body, or even of the soul" (Bell, 1976, p. 19).

The phenomenology of Merleau-Ponty (1976; 1981) puts the body at the center of action and perception, with the world coming to us from the place of one's body in the world. We understand external space, relationships between objects, as well as our relationships with objects through our position in and movement through the world via our body.

Merleau-Ponty (1976; 1981) asserted that the body is indivisible from sense of self, so it follows that dress is an important aspect of the body/self (see also Entwistle, 2000).

The body represents the maximum level of "naturalness" possible, as the artificial is increasingly extending its dominion over the natural (Fortunati et al., 2003) (see Concept No. 21, Appendix A). Wearables may be viewed as radically extending this dominion of the artificial over the natural. The body expresses who we are, what we have been, and who we would like to be, and "is extended and distorted by technology for the sake of communication and fashion" (Fortunati et al., p. 217) (see Concept No. 22, Appendix A). The human body's physical boundaries can be blurred pharmacologically and with clothing, body modifications, and plastic surgery, as some examples (Fortunati et al.). Wearables also can extend the body's boundaries, again in quite radical ways, for example, by visually capturing what one person is experiencing and sharing it contemporaneously with another person on the other side of the world.

Indeed, pairing the body with technology is both exciting and threatening, as communication technologies have expanded the body's boundaries and ability to transmit information (Fortunati et al., 2003) (see Concept No. 23, Appendix A). Young people in Finland, rather using the term *mobile phone*, use the words *kånny* or *kånnykkå*, roughly meaning "an extension of the hand" (Oksman & Rautiainen, 2003). As technology becomes more mobile and more wearable, we will increasingly perceive it be an extension of our body, and identity (see Concept No. 37, Appendix A). According to Fortunati et al. (2003, p. 2), "as technology progresses, some fear that the body will become at best a mere appendix to the machine, at worst the machine's obliterated victim." The challenge for any given wearable is to capitalize on the delight and minimize the threat, to make the wearable a *welcome* extension of both body and identity.

Dress can be used to demonstrate alignment with likeminded people or to make a political statement (Entwistle, 2000) and it works as "a kind of visual metaphor for identity" in that it overlays one's embodied self (F. Davis, 1992, p. 139) (see Concept No. 9, Appendix A). Appearance is important in the establishment and maintenance of the self (Stone, 1962). Gibbons and Gwynn (1975) theorized that people have an actual image and an idealized self-image, and that clothing represents a compromise between these two points. They found that fashionable clothing conveys an ideal self-image, and that fashionable people perceive their actual self-image and ideal self-image as more closely related than that of unfashionable people. More broadly, numerous studies have demonstrated the relationship between an individual's self-concept (in terms of attitudes and values) and the individual's choice of clothing, which reflects those attitudes and values (Buckley & Roach, 1974; Christiansen & Kernaleguen, 1971; Kness & Densmore, 1976; Levin & Black, 1970; Unger & Raymond, 1974). For a wearable to be adopted, then, it needs to be consistent with an individual's attitudes, values, and self-concept (similar to Rogers (2003)'s attribute of compatibility). For fashionable people in particular to adopt a wearable, they must find the wearable to be consistent with their image of their ideal self. Presumably, if a wearable is consistent with a person's self-image, that person will find it acceptable. If it is not, this lowers the probability of acceptance, especially for fashion-savvy individuals (see Concept No. 24, Appendix A).

Anthropologist Mary Douglas (2004) observed that the body is a natural object shaped by social forces and that it furnishes its own natural system of symbols. Indeed, the body can become a symbol of the situation. Douglas provided the example of hair and how it is worn. Shaggy hair is a symbol of rebellion, and is accepted among academics and artists because they are in a position to critique society. On the other hand, smooth hair is favored by bankers and lawyers, who more closely conform to society's rules and regulations.

Such communication via bodily symbolism extends to adornment and dress. The human propensity to communicate in symbols is at least a partial explanation for both traditional and modern adornment. Dress can be communicative, a stance adopted by many theorists (Entwistle, 2000); "clothes and other bodily adornments are part of the vocabulary with which humans invent themselves, come to understand others and enter into meaningful relationships with them" (Entwistle, 2000, p. 182) (see Concept No. 16, Appendix A). For example, the more traditional the workplace, the more formal the dress is and the more rigidly it is gendered (Entwistle, 2000). Wearables are ensconced in the technology industry, which is male-dominated. Technology workers include artists and academics, but many are engineers who tend to be more traditional, and the profession of engineering tends to reinforce the status quo (Riley, 2008). These demographics and trends affect what is designed and manufactured, as well as consumers' perceptions of what is being offered by the technology industry. At the most basic level, such products are designed to be worn somewhere on the body, attached somehow. Whether or not developers are conscious of it, their designs and products are interacting with and are adding to the symbolism inherent to the natural body. An adage in the sociology of communication is that we cannot *not* communicate (Fortunati et al., 2003). Thus wearables *do* communicate something about the wearer, but in their novelty and variation it is difficult to predict what; identifying this what is an objective of this dissertation.

Katz, Aakhus, Kim, and Turner (2003) pointed out that although matters of dress and fashion may seem distant from the communication disciplines, it is an area of communication research that likely holds considerable promise. As an example, they describe fashion as a “second skin” that projects to others how they should engage with the wearer (Katz, Aakhus, Kim, and Turner, p. 75) (see Concept No. 29, Appendix A). Similarly, Cunningham and Voso (1991, p. 11) stated that “clothing helps to define our identity by supplying cues and symbols that assist us in categorizing within the culture” (see Concept No. 6, Appendix A). The wearer of clothing or a wearable device is making a statement, which is then interpreted by the viewer. Indeed, clothing and fashion is an interaction between the wearer and the viewer (Ling, 2003).

Like dress, fashion can go on the body, in public display, and is a way to fix identity, if only temporarily (DeLong, 1998; Entwistle, 2000) (see Concept No. 18, Appendix A). Fashion allows us to demonstrate both individual differentiation and group membership (Entwistle, 2000); we can show we share a group’s ideas and values without being clones (Simmel, 1971). Thus the sociology of dress and fashion are also critical topics in considering the factors affecting the social acceptability of wearables.

2.4.3 The sociology of dress and fashion

According to Enwistle (2000), the sociology of dress is relatively small and exists on the margins of the discipline. Traditionally, sociological studies of dress ignored how dress operates on the body. Entwistle (2000, p. 11) put forth a sociology of dress that moves away from dress as object and toward dress as an embodied activity and also an activity that is embedded within social relations, proposing the idea of “dress as situated bodily practice as a theoretical and methodological framework for understanding the complex dynamic between the body, dress and culture." This approach is adopted herein because wearables cannot be understood purely as objects, but must also be considered as an embodied activity within a social context. To arrive at a sociological understanding of fashion requires a multidisciplinary perspective; whereas most research in this domain pertains to dress, fashion theories should not be constrained to dress (Aspers & Godart, 2013). Although fashion is often closely associated with dress, its theories may be applied to much broader areas of social activity, such as baby names and scientific practices (Aspers & Godart, 2013). So while fashion has an obvious bearing on wearables and their social acceptability, fashion is also applicable more generally to technology and innovation.

Although a clear definition of fashion is difficult, it has been defined as "an unplanned process of re-current change against a backdrop of order in the public realm" (Aspers & Godart, 2013, p. 171), and as characterized by a logic of regular and systemic change (Entwistle, 2000). Numerous factors structure dress in the West, including fashion, gender, class, income, and tradition (Entwistle, 2000) (see Concept No. 15, Appendix A).

Fashion has historically been located in the arts and generally ignored by sociology (Entwistle, 2000) but it is a significant sociological topic (Aspers & Godart, 2013). Various prejudices exist against fashion as a subject of serious study; it is often treated as frivolous and not worthy of serious analysis (Aspers & Godart, 2013; Entwistle, 2000). But fashion has weighty cultural and economic significance, and has been important in the development of modernization in the West (Aspers & Godart, 2013; Entwistle, 2000). German sociologist, philosopher, and critic George Simmel (Simmel, 1971) granted fashion some gravity in modern society, in that it demonstrates contradictory desires: social imitation and individual differentiation. Individually, we make choices every day about what to wear, about how we will appear to the world. In terms of society, according to Braudel (1992), a fashionable society is one that seeks to shape the world, which is hardly trivial. Societies that care about the changing colors of outerwear, shapes of shoes, and cuts of hair are the innovative societies from which progress springs (Braudel, 1992), and vast areas of social life today are subject to fashion (Aspers & Godart, 2013).

Apple Inc., one of the world's most valuable companies and brands (Elgan, 2015), is proof of the importance of caring about fashion. Apple takes seriously the fashion of computer hardware and software, and its advances in product are often inextricably linked to design (Turner, 2007). A flourishing fashion captures an emerging mood (Entwistle, 2000) and is therefore a crucial piece of understanding any given time period, including our present society. Pacifici and Girardi (2003, p. 144) succinctly articulated the importance of fashion in this era of emerging wearables: "If people wear moveable objects, created by digital technology, this must also be a personality statement. If clothes communicate and assume the functions of a computer, it will be hard to keep knowledge, ethics, and fashion behavior separate."

A new and only partially-answered question about the fashion of wearables is, can technology be fashionable? The lack of stylish options, especially for women, has been questioned. Sonny Vu, CEO of Misfit Wearables, had a goal with the Shine activity tracker: that women would be willing to show it off. He concluded that wearables must be either "gorgeous or invisible" (Wasik, 2014, p. 96). The prediction is that designers will increasingly collaborate with technology companies to better evolve from a style and fashion perspective (Gaddis, 2014). Indeed, this is already happening; in 2014, companies like

Apple and Intel dedicated entire teams to style and fashion (Losse, 2014), but such pairings were still quite rare (Wasik, 2014).

Historically, technology's relationship to fashion is full of contradictions. On the one hand is the term "nerd," which simultaneously means 1) a person who is awkward and unstylish and 2) a person who is very interested in computers and other technical topics (Nerd, 2015). Most PCs are flavorless black boxes with wires sprouting out the back, or as Norman (2008) saw it: entrails, ugly infrastructure, and unsociable design. Thousands of "skins" are available for one's mobile phone to cover up their sameness and lack of style. On the other hand, it is de rigueur for teens to carry a mobile phone, and Beats (by Dre Studio) headphones have come to be known not just for their audio quality, but as a highly fashionable accessory (Leopold, 2014). One piece of Beats' success has been the limited edition seasonal colors put out every six months, and tiny runs of custom headphones (Wasik, 2014).

The designer of Beats, Robert Brunner, offered this explanation as to why technology and fashion tend to be at odds: the early adopters of technology do not necessarily provide the "aspirational dynamic" that would typically push fashion products into the mainstream (Wasik, 2014, p. 99) (see Concept No. 59, Appendix A). Brunner further stated that generally technology companies don't understand the complexity of the technology-fashion relationship (Wasik, 2014).

While attractiveness of a product that is worn on the body is crucial, it is not enough. Wasik (2014) asserted that to be fashionable, a worn device needs to meet two criteria beyond a pleasing aesthetic. One, the wearable needs to convey a message the wearer is happy to send (see Concept No. 60, Appendix A). For example, the Jawbone Bluetooth earpiece is beautiful but it sends the wrong message: that the wearer jumps "at the world's beck and call rather than engaging with it on their own terms" (Wasik, 2014, p. 96). Two, once a wearable gains acceptance (once everyone is wearing something), it's no longer cool. This does not apply to a technology like the mobile phone, because phones are not worn on the body. But what if everyone in a meeting is wearing the same glasses? This is not acceptable, and this urge for individuality is well-known in fashion research (Wasik, 2014) (see Concept No. 61, Appendix A). For example, a study of maternity wear found that women were concerned that the choices available did not allow them to express their true selves, and in fact symbolized someone they did not want to associate with (Ogle, Tyner, & Schofield-Tomschin, 2013). Similarly, limited choices in wearables may turn people away (see Concept No. 36, Appendix A).

2.5 Case study: Eyeglasses to Google Glass

A close examination of a particular case for analysis will provide further insight into factors affecting the social acceptability of wearables. While the subject of the case study is Google Glass, eyeglasses have of course preceded Glass by many centuries, and it is informative to understand their history and the course of their social acceptance. This history of eyeglasses and eyewear is important in understanding Google Glass, because Glass is a type of eyewear. People's perceptions of social acceptability of Glass have some relation to that of eyeglasses, while also adding complications given Glass's video recording capabilities and other potentially socially disruptive features. The evolution of social attitudes towards eyeglasses helps explain and predict the course of wearable social acceptability. Also, many new and prototyped wearables are worn like eyeglasses, or are worn on the head, thus increasing visibility and social consequences and making them akin to eyeglasses.

2.6.1 Eyeglasses

According to Segrave (2011), before the invention of the printing press in the 15th century, it was largely monks in monasteries who were the "printers," and intensive writing and studying in monasteries took a toll on eyes. Eyeglasses were initially worn mostly by scholars and monks, and teachers and others who could read, which likely lead to their long-standing association with learning and wisdom. However, at the time of the invention of spectacles, around the 15th century, many scholars considered such tampering with nature to be a sin, and it took some courage to wear them (Hamblin, 1983; Segrave, 2011). As with many early scientific discoveries, glasses were associated with witchcraft and were imagined to promote depravity (Segrave, 2011).

Such attitudes toward eyeglasses continued into 17th century, when there was a reversal: glasses came to represent virtue and wisdom, as men of distinction wore them. Street vendors and gypsies hawked the benefits of spectacles, including power and wealth. Green lenses were said to help arthritis while red lenses were sold as a cure for housewives' corns (Rosenthal, 1937; Segrave 2011).

Glasses were considered acceptable only for men until the 17th century, when the lorgnette appeared, to aid ogling at the opera, theater, and court (Segrave, 2011). A lorgnette is an ornate miniature telescope held in front of the face by a long handle, and was originally constructed for one eye only. Women's interest in the lorgnette inspired many designs, including the jealousy lorgnette, which had a lens at each end and an oblique mirror through which its user could see who was behind or to the side. The jealousy lorgnette solved an etiquette conundrum: it was poor manners to turn around and see who was behind one at the theatre—yet people desired this information. Although controversial, the jealousy lorgnette's contentious nature only seemed to fuel its popularity; anyone remotely distinguished or stylish carried one (Hamblin, 1983; Rosenthal, 1937; Segrave 2011).

The pince-nez was developed around 1650, which consisted of bonacles with no stems that were held with the hand. In the 19th century, flexible springs were invented, so eyeglasses' popularity was renewed, as wearers could now clip them to the nose. For reasons unknown, glasses at this time came to be associated with snobbery, rank, and class consciousness (Rosenthal, 1937; Segrave 2011). Like the pince-nez, the monocle (introduced in England about 1800) quickly became known for its snob appeal (Hamblin, 1983; Segrave, 2011).

It was not until 1730 that a British optician perfected the use of rigid sidepieces, solving the problem of how to keep eyeglasses on one's face (Segrave, 2011). While glasses could now be worn continuously, they were not necessarily accepted as such; the French were self-conscious about wearing them and generally kept them in hiding, just pulling them out for a quick look. However, in Spain, glasses were far more accepted, because people felt they made them look dignified and important, with lens size seen as commensurate with one's fortune (Hamblin, 1983; Segrave, 2011). In England in the 1800s, how the glasses looked was considered more important than their functionality (Rosenthal, 1937). Eyeglasses, however, were not considered acceptable for women; for example, in 1900 an American doctor stated that they were disfiguring to women and girls (Hamblin, 1983; Segrave, 2011) (see Concept No. 48, Appendix A).

According to Segrave (2011), advances in materials science allowed the development of eyeglass stems, revolutionizing eyewear, and other developments in technology affected the design and use of eyeglasses. For example, as the automobile gained in popularity, marketers sold specialized products, including eyeglasses to protect from wind and dust, and other eyewear that was touted for safer night driving. Various patents were filed for variations on typical eyeglasses, modifying eyewear to be specialized for activities such as spying, surveillance, and "girl-watching" (Segrave, 2011).

This brief history is an illustration of how new technology is nearly always met with criticism and a fear of the new, and indeed, many wearables have met a similar fate. Future wearable devices will likely experience a slow and uneven path to social acceptance (or perhaps, demise). As stated above, the invention of lenses to aid sight received various social criticisms, and as eyeglasses gained popularity into the 20th century, critics continued to voice their concerns. For example, in 1925, French critic De Trevieres mourned the loss of the invisibility of former styles like the pince-nez and complained about the obtrusiveness and heaviness of modern spectacles like the tortoiseshell ("two aggressive lenses like automobile lamps"). He stated that "formerly a young person wearing spectacles would have been regarded as ridiculous," and concluded that American influence had led to the adoption of such an inanity, but that was not enough to justify "universal adoption" (The age of spectacles, 1925, p. 57; see also Segrave, 2011) (see Concept No. 49, Appendix A).

According to Segrave (2011), Medicare/Medicaid programs, eye exams for drivers' licenses, school screenings, and glasses as a fashion item have all affected the growth of eyeglasses and contact lenses since the 1970s. In 2007, about 75% of adults in the U.S. used vision corrective devices (glasses or contacts), and half said they would consider wearing eyeglasses as a fashion statement even if they did not need them for vision (Eyewear perfect fit, 2008). If a wearable also provided an assistive function and was required for certain activities and/or was medically reimbursable (like eyeglasses), this similarly would affect the its course of acceptability and adoption.

Numerous studies by psychologists provide insight into common social perceptions about people who wear eyeglasses. A 1982 experiment in which participants were Australian university students found that as compared to a person without glasses, a glasses-wearing person was seen as more intelligent, hardworking, and successful, but less active, outgoing, attractive, popular, and athletic (Harris, Harris, & Bochner, 1982). In a study with 90 Florida college students, regular glasses enhanced a person's perceived authority, while sunglasses lowered it. However, eyewear did not impact perceptions of wealth, attractiveness, sexiness, or character. The authors suggested that a person endorsing a product is more persuasive if wearing glasses (Bartolini, Kresge, McLennan, Windham, Buhr, & Pryor, 1988). Harris (1991) again studied perceptions of eyeglass-wearers in 1991 with 217 adults, finding that the stereotypes were overwhelmingly positive. Glass-wearers were rated as more intense and intelligent; however, one lasting negative stereotype was unattractiveness. These stereotypes would likely apply also to wearables that are similar to eyewear.

Sunglasses have a different history than prescription eyewear and also diverge from typical eyeglasses in terms of social attitudes. According to Segrave (2011), aviator glasses were developed in the 1930s in response to Army pilots' complaints of eyestrain, headaches, and nausea. Around the same time, celebrities like Katherine Hepburn started wearing sunglasses, resulting in increased mainstream sales. Over the years, certain styles were popularized by certain people in the media, e.g., Jacqueline Kennedy's large curved sunglasses in 1961. One industry executive said that the Kennedys were the most important booster to the business since Garbo, while another said women had begun treating sunglasses like cosmetics, purchasing multiple styles and using them as an image-enhancer (Bart, 1963). A wearable has the potential to follow a similar trajectory to acceptability, that is, military adoption followed by celebrity adoption.

According to Segrave (2011), in the 1970s sunglasses were seen as an important wardrobe accessory, and the in the 1980s, sales were further fueled by the movie *Top Gun* and the TV show *Miami Vice*. Starting with a single kiosk in 1972, Sunglass Hut grew to 540 mall locations across the United States by 1992. President Jack Chadsey said the goal was to make sunglasses like shoes, in that everyone will own multiple pairs. The well-trained staff "analyze the 'function' and 'fashion' components of sunglass desirability" (Glaberson, 1992). Wearables may too require their own stores with a well-trained staff, to similarly analyze function and fashion. Just as *Top Gun* propelled the sale of sunglasses, a movie has the potential to make a new wearable fashionable, and thus significantly affects its socially acceptability.

2.6.2 Google Glass

Prescription eyewear and sunglasses can be understood as the first wearable technologies worn over the eyes. The evolution of their social acceptability, as described in the above section, should therefore contain parallels to the social acceptability of newer wearable technologies being prototyped and appearing on the market. Google Glass was one of the first mass-market wearable technologies that was worn like eyewear, with a small prism-like screen suspended in front of the upper corner of the user's right eye, and is therefore a useful case study in identifying the factors affecting acceptability of a wearable.

According to Bilton (2015), the concept of Glass was born in the late 2000s, when Google's founders and a few upper executives produced a list of 100 futuristic ideas, of which wearable computers captured the most excitement. Through 2010 and 2011, this idea of virtual or augmented reality eyewear was kept under strict secrecy as Project X. Its engineers disagreed about its basic functions: should it be worn all the time as a fashionable device, or should it be worn only for certain, utilitarian purposes? The engineers did agree that Glass was a prototype. However, Sergey Brin, Google's co-founder, wanted further development to occur in public, rather than in a secret lab. Brin believed that consumer feedback should be used to iterate and improve the Glass prototype. To underscore the "unfinished" nature of the product, Glass was initially released only to select "Glass Explorers"—essentially technology aficionados and journalists who paid $1,500 to be its first adopters (Bilton, 2015).

The general purpose of Glass was to keep its user "plugged in"—e.g., interacting with emails and calls—without looking at one's smartphone. Glass had a touchpad on its right stem that could be tapped or swiped for navigation. The voice command "Okay, Glass" prompted further commands (e.g., for taking a photo or launching an application). The "heads-up" display was touted as a novel feature that allowed users to simultaneously perform an activity and consume information, such as finding and reading a recipe while cooking (Tsukayama, 2014).

When unveiled in 2012, interest in Glass was intense (Bilton, 2015). *Time Magazine* named it one of the best inventions of the year and it was coveted by a variety of people, including CEOs and fashionistas. It appeared on the runway in a Diane Von Furstenberg show and in a Vogue spread. But the excitement did not last. Technology reviewers quickly enumerated their gripes about Glass, people voiced privacy concerns, and Glass was banned in places such as bars, movie theaters, and Las Vegas casinos (Bilton, 2015).

Indeed, the video recording functions probably proved to be Glass' most-controversial feature. While a small light indicated that Glass was recording, this recording could be conducted far more surreptitiously than with a cell phone. Google responded to these concerns with an education campaign, training its beta-testers in good etiquette with Glass and educating policymakers about how the technology works (Tsukayama, 2014).

Wired magazine (Wasik, 2014) stated that Glass was quite attractive— but its attractiveness was not enough. As an obvious addition to one's public person, it also needed to be fashionable. As the verdict was out on whether Glass could indeed be fashionable, consumers were meanwhile staying away because of privacy and safety fears (Collins, 2015).

By 2013, backlash included the "Stop the Cyborgs" anti-Glass campaign and the term "glasshole" appearing in the media as a reference to people who did not properly take into account the social acceptability of wearing such a device. As explained by linguist Ben Zimmer, the term is a variation on the epithet "asshole," which is a moral category implying inauthenticity (Greenfield, 2013). In January 2015, Google abruptly announced the end of its Glass Explorer program, but reportedly Ivy Ross, a jewelry designer, and Tony Fadell, a former Apple product executive, were working on redesigning Glass from scratch in 2015 (Bilton, 2015).

Although Glass did not succeed in the way its developers imagined, it did still leave a prominent impression. For example, fashion designer Diane von Furstenberg, who both wore Glass and featured it on her models, stated she had no regrets and said that Google Glass was nothing short of revolutionary. "This was the first time that people talked about wearable technology," she said. "Technology moves on faster and faster, and Google Glass will always be part of history" (Bilton, 2015).

2.6.2.1 Google Glass was creepy

"Creepy" was a recurring descriptor of Google Glass as it made its way into public consciousness (see Concept No. 5, Appendix A). Creepy has negative connotations that range from mild (unpleasantness) to moderate (unease) to severe (fear). Glass had been out about a year when BBC technology correspondent Cellan-Jones (2015) posed the question "Google Glass: Cool or Creepy?" in an article title, but he did not supply an answer. An article in *Scientific American* had explained Glass's creepiness in terms of its biggest obstacles for social acceptance: the smugness of people who wear Glass and the discomfort of people who don't wear Glass (Pogue, 2013) (see Concept No. 38, Appendix A). An *MIT Technology Review* the following year stated that Google must convince people that Glass is not too creepy for it to be accepted (Garfinkel, 2015). Finally, in response to the announcement that Google would stop selling Glass, *The Chicago Tribune* Editorial Board called Glass "the creepy innovation we didn't want" (Editorial Board, 2015). Glass did not clearly solve any problems, they stated, but did pose potential risks to privacy, anonymity, and self-respect (see Concept No. 13, Appendix A). The Editorial Board saw Glass' failure as a case in point of the principal that innovations require the public's interest and consent; collectively we weigh an innovation's benefits versus costs, and there is no straight line to acceptance and adoption (see Concept No. 14, Appendix A)

Tene and Polonetsky (2013) put forth a "theory of creepy" in the wake of new technologies, privacy concerns, and shifting social norms. Whereas community norms until quite recently guided the ethics of privacy, rapid technological innovation is now forcing us to rely on our intuition of right and wrong, often on the fly. A shared understanding of how our social values should align with our technological capabilities is thus quite elusive. The authors suggested that “creepy” has come to mean, in privacy policy, a lack of alignment between technological capabilities and social norms. In articulating a theory of creepy, they sought to help individuals, engineers, businesses, and policymakers navigate this new world, calling it critical for businesses to “operationalize these subjective notions into coherent business and policy strategies” (Tene & Polonetsky, 2013, p. 60). They used the term “techno-social chaos” to refer to the tight and often tense interaction between social norms and technological developments.

Tene and Polonetsky (2013) observed that commentators and customers tended to label a corporate technology-related behavior “creepy” when it used data in a new way or removed obscurity, but without going so far as to breech the law or cause harm (see Concept No. 53, Appendix A). In its list of examples, they included Google Glass, noting that in its case it is the privacy of other people that is potentially threatened, rather than the user’s privacy. Therefore, such novel technology forces new etiquette to be developed or existing etiquette to evolve.

Three main vectors drive changes that affect individuals’ perceptions of privacy and social norms: business, technological, and individual (Tene & Polonetsky, 2013). Businesses push more users to engage more often and share more data because that results in profit; it is a successful business model. How technology drives techno-social change is simply evidenced by the speed with which innovation is happening:

> Less than a decade ago, few had the foresight to imagine that most people today would be walking with tiny devices containing multiple high resolution digital video and still cameras, microphones, speakerphones, media players, GPS navigation, touch screen, web browser, Wi-Fi and mobile broadband connections, and multiple sensors including an accelerometer, proximity sensor, ambient light, and compass, as well as access to hundreds of thousands of applications, typically offered free of charge or at negligible cost (Tene & Polonetsky, 2013, p. 78).

Finally, individuals share personal information on social media because it satisfies very basic needs and desires. However, what to share about oneself, and what to pass along of others' sharing, is open for debate.

Tene and Polonetsky (2013) thus suggested that the colloquial term "creepiness" derives from the failure of individuals and industry to adjust their actions when using new technologies, resulting in a misalignment with current social norms (see Concept No. 54, Appendix A). It is apparent that Glass's failure falls into this misalignment. Companies cannot treat privacy law as the floor of privacy concerns; instead they must have meaningful conversations with consumers to address any suspicions and align expectations (Tene & Polonetsky, 2013). While Google did attempt to do this with Glass, it was in reaction to existing issues and criticisms, and may have been a case of too little, too late.

Tene and Polonetsky (2013) put forth some strategies to help businesses absorb rapidly evolving social norms and thereby avoid creepiness in product development. Engineers should avoid technological determinism; that is, just because something is possible does not mean that it should be done. They should guard against privacy lurch by avoiding a "throw-it-at-the-wall-and-see-if-it-sticks" attitude. Businesses and engineers should also understand that the typical user is not a tech-savvy “super-user” but instead an average person who clicks “yes” to user agreements without reading, gets privacy settings wrong, forgets passwords, and disseminates more information than intended. “Turning on the light” is a good strategy to avoid creepiness; in other words, businesses should be open and transparent about their data practices, purposes, and needs (see Concept No. 55, Appendix A). Finally, the golden rule: people in industry should treat consumers as they themselves would like to be treated. Product developers should think about how users might find it easy, or difficult, to engage the golden rule when using the product, for example, sharing others’ personal information without their knowledge or consent (Tene & Polonetsky, 2013).

Moreover, broader societal expectations and values often do not mirror the culture of Silicon Valley (Tene & Polonetsky, 2013). While the tech world’s main annual conference is called “Disrupt,” and entrepreneurs are often rewarded with brazen behavior, such audacity translated into product may then result in terms such as “Glasshole.”

Therefore, looking at both the rise and fall of Google Glass, and the theory of creepy (Tene & Polonetsky, 2013), the concept of creepy is closely related to privacy concerns. The more a wearable’s functions raise privacy concerns, the less socially acceptable it will be (see Concept No. 56, Appendix A).

2.6.2.2 Google Glass was not cool

In a Google Glass postmortem in the Harvard Business Review, Haque (2015) stated that Google Glass failed not because of its look or price, but because it was a visionary product that failed to be *cool*. While Haque suggested that cool is a crucial factor in the success of new products, it is important to parse out the context. That is, cool is crucial for what we wear, or are seen with (mobile phone) or in (automobile). Cool is less important (but perhaps not irrelevant) for home products such as a DVD player, vacuum cleaner, or dishwasher. For a product that rests on one's face, the concept of cool is primary.

Haque (2015) went on to argue that cool is not something that can be engineered by Google workers, like an algorithm, but is instead like art—mysterious and ineffable. Thus, Google's desperate attempts to force Glass's coolness backfired. Ultimately cool is about liberation, about imagining the world as it *should* be and giving people the power to realize their visions. Glass did the opposite; it thwarted individuality and threatened people (e.g., with surreptitious recording) (see Concept No. 26, Appendix A).

Mentges (2000) examined the relationship of the concept of "cool" with dress, body, and technology. James Dean or Marlon Brando in movies from the fifties came to be known for their expressions of "coolness" via their clothing. Literally, cool means coldness, which metaphorically conveys ambivalence and restraint. Coolness is generally associated with youth culture and a particular kind of dress, body language, and bearing.

But even beyond being related to certain materials and types of dress, stated Mentges (2000), cool is related to technology—in particular, sport and war. In America, "cool" as an attitude was first observed in the 1920s, after World War I, in which aircraft were used for the first time on a large scale. Aircraft both transported pilots above the clouds, and potentially to their deaths; "only by skillfully handling the engine, by keeping coolheaded, would they survive and be victorious" (Mentges, 2000, p. 31). The new aircraft technology also brought about a change in military dress. Whereas the splendor of uniforms were previously symbolic of power, in World War I the leather jacket became the most important item of dress. Thus the now-classic leather jacket appeared for the first time in the milieu of modern engineering (aircraft) as well as motorcycles and automobiles.

Modern technology, Mentges (2000) explained, makes bodily strength obsolete, thus resulting in an attitude of coolness. While previously strength required bodily control, now humans control machines, which requires mastery of the senses and the mind. At the same time, the machine as an extension of bodily forces provides the user a feeling of power and superiority. In the first decades of the automobile, people protested the machine and its operators as aggressive and “out of proportion to the human scale” (Mentges, 2000, p. 37). Drivers, at best viewed as inconsiderate and at worst the cause of accidents, were attacked by pedestrians (Radkau, 1987, as cited in Mentges, 2000). The parallels to Google Glass, and lessons for new wearables, are clear: technology gives humans new powers; society will in time produce social norms for handling these new powers; but in the interim, protest ensues.

Mentges (2000) concluded that “coolness does not simply signify a casual attitude or a particular mode of behavior. Within the context of new developments in technology and in particular new means of mobility, where the body is exposed to extreme conditions caused by velocity, coolness is the construction of a new corporal language and an entirely new discipline of the body and the mind” (Mentges, 2000, p. 42). Mentges predicted that “techno-textiles” developments will further serve to extend and broaden the body’s innate power.

Google Glass, then, was creepy not cool. It was disruptive in a negative sense, in that it was annoying, by disturbing social norms and adding confusion to conventional human interaction (Baraniuk, 2015) (see Concept No. 3, Appendix A). People perceived its users as smug, causing discomfort (Pogue, 2013). Smugness is not cool; probably early drivers were considered smug as well. Yet the early pilots *were* considered cool, and importantly they were not the engineers, they were the working class mechanics (Mentges, 2000). Many of the early adopters of Google Glass were the Google engineers and Glass developers, but Mentges's work suggests that a more successful path to mass adoption may in the future be led by working class people, for whom a wearable would make their lives freer, liberating their individuality.

This case study concludes the literature review, which is the first step in scale development, to define the construct and outline its domain (DeVellis, 2012; Netemeyer, Bearden, & Sharma, 2003). From this literature review, the author identified concepts for use in construct definition and item generation (Appendix A). These concepts from the literature review were used to produce the interview questions in Study 1, and then used in conjunction with the interview data to generate the Initial Item Pool v.1, as explicated in the next chapter.

Figure 2 provides an overview of the construction of the WEAR Scale and shows how these 61 concepts from the literature are the first building blocks in the generation of items. These concepts informed the writing of the interview questions in Study 1, the results of which were used to write scale items. These scale items were then compared to the literature, and concepts in the literature that were not yet represented resulted in additional items. The resulting 73 items (WEAR Scale v.1) were then reviewed by experts. The resulting 50 items (v.2) were edited slightly in a pilot, resulting in WEAR Scale v2.1 and administered in Studies 3 and 4. Factor analysis and related scale development procedures finally resulted in the final WEAR Scale v.3.

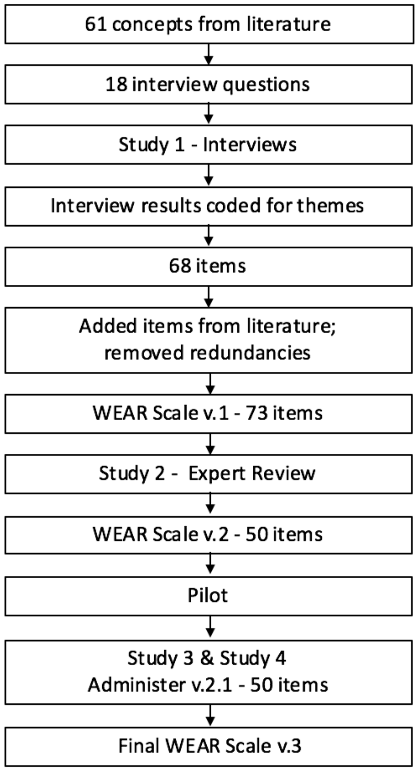


Figure 2. Overview of the construction of the WEAR Scale.

CHAPTER 3

STUDY 1 AND RELATED DEVELOPMENT

Chapter 3 covers DeVellis (2012)'s first three steps in scale development: determine what is being measured, compose the item pool, and determine scale format (see Table 1). Section 3.1 presents the process for determining what is being measured, which is accomplished via a qualitative analysis of the literature review and an interview study of the intended population (Study 1), and results in a definition of the construct*, social acceptability of a wearable*. As previously explained, this process establishes an argument for content validity. Section 3.2 presents the process for determining the scale format and composing the item pool, which results in the Initial Item Pool v.1.

3.1 Determine What Is Being Measured

As described in Chapter 2, before the content of a new scale can be drafted, the researcher must define and understand the underlying construct, and articulate its connection to relevant existing theories, to aid to clarity in scale development (Clark & Watson, 1995; DeVellis, 2012). Chapter 2 described the related literature and existing theories that inform an emerging theory of social acceptability of wearables. Existing related theories help identify the boundaries of an emerging phenomenon, so that the scale does not unintentionally drift into other domains (DeVellis, 2012). Theories can drive, and also be the outcome of, the research process of coding qualitative data (Saldana, 2009). This study, as previously discussed, began atheoretically, with qualitative data that will directly lead to scale items; use of the resulting WEAR Scale can then in consequent research be used to test hypotheses and develop theory.

Therefore, the first step of devising the WEAR Scale is to formulate a definition of the phenomena of "social acceptability of a wearable device" and describe how this construct relates to other phenomena and their operationalizations (DeVellis, 2012). As discussed in Section 2.1, a database of well-organized raw data forms a chain of evidence that allows the researcher to demonstrate that her interpretation of the data is firmly grounded in the data (Lazar, Feng, & Hochheiser, 2010; Yin, 2003). In the present research, such a database starts with the literature review (Appendix A) followed by the results of an interview study of the intended population (Study 1, below). The definition of the construct (3.1.2) then emerges from these data.

3.1.1 Interview Intended Population (Study 1)

In the development of a scale such as the WEAR Scale, an item development study as an initial phase of scale development can form the basis of an argument for content validity. Interviews can help the researcher understand the thinking and the vocabulary of the target group, and discover topics addressed by potential respondents (DeWalt, Rithrock, Yount, & Stone, 2007). DeVellis (2012, pp. 60-61) described the process used by Sterba, DeVellis, Lewis, Baucom, Jordan, and DeVellis (2007) to form the basis for content validity: "The study aimed at identifying appropriate content from the broader empirical and theoretical literature for possible inclusion in the measure. Although the authors examined content from measures of related constructs…they geared their item development to specific features of the construct as they [participants] had defined it."

Thus, Sterba et al.'s item development study included interviews with the intended population to obtain feedback on whether the construct made sense to them, and to gain information on participants' conceptualization of the construct and the language they used to talk about it. Similarly, Yildirim and Correia (2015) used interviews in developing a 20-item nomophobia questionnaire (NMP-Q). In that study, the interviewee's words provided an in-depth description of the dimensions of nomophobia (fear of being without one's mobile phone), a phenomenon about which little is known. This initial qualitative approach helps the investigator understand the construct as the population of interest does, information which is then converted to a "mathematically tractable quantitative form" and subjected to factor analysis (DeVellis, personal communication, May 11, 2015).

3.1.2.1 Methods

According to Lazar, Feng, and Hochheiser (2010) and Yin (2003), interviews can be analyzed using various qualitative data analysis methods. Such methods identify common or repeated themes and structures among and within participants. One such technique, which was implemented in this study, is content analysis. The researcher conducts content analysis by examining the frequency of terms that may indicate concepts, and the relationships among concepts. It assumes that the interviewee's comments evidence what he or she finds important, and why (Robson, 2002). Another approach is to categorize interview content, which are either pre-defined or defined after analyzing the text (Lazar, Feng & Hochheiser, 2010). In this case, categories were identified using the substance of the interviews. Ideally, interview results are presented with specificity and clarity, e.g., providing exact frequencies of a type of comment and using the interviewee's choice of words (Lazar, Feng & Hochheiser, 2010). This method, as well, was implemented in the present analyses.

For the WEAR Scale, the target population was defined as persons aged 18 to 30 for a two main reasons. One, because technology is typically developed by younger people for the use of younger people and marketed at younger target groups (Van Hemel & Pew, 2004), the author felt that sampling from this population was appropriate in developing the WEAR Scale. Two, the accessible population for developing the WEAR Scale largely consists of college students at a Midwestern university. In their comprehensive review of published research on dress and human behavior, Johnson, Yoo, Kim, and Lennon (2008) found that college students were used in 19.1 percent of the studies. For many studies, including scale development, the college population might well-represent the general population; it depends on the scale (Spector, 1992).

Interviews were conducted with the target population (people aged 18 to 30) to gain information on this population's conceptualization of the construct "social acceptability of a wearable" and the language they use to talk about it. The objective of such interviewing in scale development is to use the resulting key phrases and ideas gathered from the target population in defining the construct and in writing the initial item pool (DeVellis, 2012; Clark & Watson, 1995).

Participants were recruited at Iowa State University via campus mailing lists, fliers, and personal contacts of the researcher. Upon arrival, the participant read and signed consent documentation approved by the Institutional Review Board under IRB 15-306 (Appendix B) and completed a brief demographic survey. The participant was then interviewed about the term "wearable" and the concept of "social acceptability" (Appendix C, *Development of a Scale to Measure Social Acceptability of a Wearable Device Interview Questions*).

A total of nine participants were interviewed, seven of whom were male. The number of participants used is similar to other studies implementing interviews in scale development, e.g., Yildirim and Correia (2015) interviewed nine people in developing their nomophobia questionnaire. The ratio of male to female is a limitation of the present study, and the researcher was sensitive to this shortcoming as the data were translated to scale items. Two of the three expert reviewers who provided feedback on the initial item pool in a later phase of development (expert review) were female, which additionally mitigated the male-majority interview sample. Because interviewing is resource-intensive, large representative samples are generally not possible; however, interviewing does result in a rich qualitative data set (DeWalt, Rithrock, Yount, & Stone, 2007).

The participants ranged in age from 19 to 30, with a mean age of 25. Seven identified as White, and not Hispanic or Latino; one identified as White, and Hispanic or Latino; and one identified as Black or African American, and not Hispanic or Latino. All participants were residents of Iowa and had at least some college education; three had earned graduate degrees. Most were either currently full-time students (4) or part-time students (3). Fields of study included sports medicine, graphic design, psychology, industrial engineering, and human computer interaction. Interviews ranged in time from 18 to 58 minutes, with a mean length of 36 minutes.

Each participant was interviewed about the term “wearable” and the concept of “social acceptability.” The questions were formulated following the comprehensive review of the literature, and were thus informed by its findings. Both the interview questions and the method of analysis for each are described in the next section. For Questions 9 through 12, participants were shown images of wearables and read a description of each. In this study, the researcher typed notes of the participants' responses during the interview, and also audio-recorded the interview as a back-up. After each interview, the researcher analyzed the notes and entered key words and phrases in a spreadsheet, to collect frequencies on responses that could be quantified and to distill comments into common categories.

3.1.1.2 Results and Discussion

Results from the 18 interview questions are presented and discussed below. When appropriate, data tables are used to show how the participants' responses were categorized and quantified. Categories are presented in order of frequency of responses that were assigned to that category.

Q1: Meaning of "Wearable"

The inquiry started broad; participants were first asked "What does the term 'wearable,' as in wearable device or wearable computer, mean to you? Start with the top 3 words or phrases that come to mind." Answers were examined for conceptual commonalities and tallied. Five categories emerged from the data, as shown in Table 2.

Table 2.

Meaning of "Wearable"

Category	Phrases
Generic objects (8 responses)	Augmented reality systems (e.g., on head), cell phone, headset, integrated into clothing, miniature mobile device, running watches, watches, wristband.
Brand devices (6 responses)	Apple Watch (2 mentions), Fitbit, Google Glass (2 mentions), Oculus Rift.
Physicality (6 responses)	External, hands free, on top of body, tangible, outside of the body, technology that you can take on and off easily.

Table 2. continued

Category	Phrases
Judgment (5 responses)	Adoptable, encumbering, flexible, goofy-looking, techie.
Purpose (2 responses)	Biometrics, fashion.

The first three categories showed that the majority of participants (74%) thought of a wearable as a physical object, either a generic or specific device, or more generally in terms of its physicality. A less common response (18%) involved the participants making a judgment about wearables, and lastly, a couple responses (7%) referred to the potential purpose of a wearable. There was little duplication of responses – only Apple Watch and Google Glass were each repeated.

Q2: Wearable Ownership

Participants were next told that some examples of wearables were the Fitbit, the Apple Watch, and Google Glass, and were asked whether they owned any wearables, which ones, and their overall experience with each device. Seven participants (78%) said they did not own any wearables. The remaining two owned one wearable each: a fitness watch, for which the participant did not know the name; and a Polar Loop, which is a wrist-worn activity tracker. The participant with the fitness watch stated that although not user-friendly, it helped her reach her goals. The participant with the Polar Loop said it was fine, but noted that a metal part could scratch and the device could get uncomfortable. Thus, the majority did not have personal experience with regular wearable use. Of the two that did, their experiences were mixed.

Q3: Wearable Familiarity

Participants were then asked to talk about some wearables with which they were familiar, so that existing knowledge of wearables could be assessed. Table 3, Table 4, Table

5, and Table 6 categorize responses for each type/brand mentioned, so that comparisons could be made and patterns identified.

Each participant mentioned between one and three wearables in response to this question. Google Glass was the most frequently mentioned wearable (67%) and, notably, the first impression was positive for all participants. Participants were split, however, as to whether that positive first impression was maintained. For participants who presently felt positive about Google Glass, this positive feeling was attributed to novelty, curiosity, and/or usefulness. For participants who presently felt negative about Google Glass, the reasons stated were that Glass provided too much status, too much power, and too many capabilities, and that Glass was "ridiculous."

Table 3.

Google Glass

First impression	First encounter	Overall current impression
Positive	Media	Positive
Positive	Media	Positive/ambiguous
Positive	Media	Positive (mostly)
Positive	Media	Negative
Positive	Media	Negative
Positive	In class	Negative

Table 4.

Apple Watch

First impression	First encounter	Overall current impression
Neutral	Media	Positive
Could be interesting	Coworker	Positive/ambiguous
Negative	Media	Positive (mostly)

Table 5.

Smartwatch/Android watch

First impression	First encounter	Overall current impression
Neutral	In class	Neutral
Negative (mostly)	Media	Negative

Table 6.

FitBit/FitBit type devices/Garmin GPS watch

First impression	First encounter	Overall current impression
Positive	Person	Positive
Positive	Media	Neutral to positive
Positive	Media	Neutral to positive

Smartwatch-type wearables (including Apple Watch) were mentioned by about half of the participants (56%). The first impression reported for these devices was neutral or negative. Wrist-worn fitness wearables such as the Fitbit and Garmin were mentioned by a third of participants (33.3%) with all stating they had a positive first impression, which was largely maintained.

Q4: Wearable Criteria

Participants were asked what the important criteria are when considering a wearable. Their 29 open-ended responses were grouped according to conceptual commonalities, resulting in four categories: functionality, consequences, aesthetics, and ergonomics (Table 7).

The most frequently-appearing category of criterion was functionality, closely followed by consequences, which for the most part could be divided into costs versus benefits. One participant thought that the social consequences, both positive and negative, were an important consideration. Although no other participant mentioned social criteria specifically, the criteria in the aesthetics category relate most closely to the concept of social acceptability.

Participants were then prompted to comment on the following criteria (which had been identified in the literature review), if they had not mentioned them previously: functions; how it looks; fashion/trendiness; as an expression of yourself; location on the body and whether it's obvious or not; and how users interact with it. Most participants mentioned functions and/or how it looks in the open-ended question. Of those who did not, when prompted, all agreed that functions and looks are at least somewhat important criteria. While only one participant offered that fashion was important in the open-ended response, when prompted, four people said fashion was important, two said it depends, and two said fashion is not important.

Table 7.

Important Criteria When Considering a Wearable (open-ended)

Category	Criteria
Functionality (10)	Battery life (2 mentions); functionality; functionality – needs to be useful; functions – not too many; Internet access and email; usability (ease of use); usability (user-friendly, intuitive); utility; utility (provide utility or service).
Consequences (8)	Benefits; benefits versus distractions; benefits—what it does for me; cost; cost (price); cost to individual; cost to society; social (effect on).
Aesthetics (7)	Casual versus formal; fashions; pleasing (doesn't look like trash); sleek; sleek not clunky; style (my kind); trending.
Ergonomics (4)	Comfort; not bulky; physically does it get in the way; size (conveniently small).

Fashion has been identified in the literature as a crucial variable in wearable success and social acceptability (Rogers, 2003; Wasik, 2014). However, only one participant (male) offered that fashion was important in the open-ended response. When prompted, participants answered “no” or “it depends” primarily for two reasons: 1) a wearable should not be trendy because then it will be short-lived; and 2) fashion is important to only some people, not all people. These responses are interesting in that they undermine the assumption in the literature that a wearable must be fashionable. They further suggested that social acceptability does not depend on fashion, and in fact, trendiness may not be a desired criterion for potential users. However, the small and heterogeneous sample presents a limiting factor in drawing conclusions.

What we wear is an important act of self-expression (Adam & Galinsky, 2012; Cunningham and Lab, 1991), yet nobody offered this criterion in the open-ended response. When prompted, four participants agreed with this, while five participants stated no, or it depends.

Lastly with regard to criteria, participants were asked if a wearable’s location on the body and interaction style (direct versus via a smartphone) were important. All participants stated either yes or it depends for these criteria. Location on body was most commonly associated with obviousness – the more obvious, the more important this criterion. There were a variety of opinions offered regarding interaction style, but no participant offered a strong preference for a particular way of interacting with a wearable.

Q5: Meaning of “Socially Acceptable”

Question 5 introduced the concept of social acceptability. Each participant’s response to What does “socially acceptable” mean? was distilled into a few phrases (two to six for each person), resulting in a total of 26 phrases. These phrases were then examined for conceptual commonalities, resulting in four categories: others’ reactions, qualities of the device or wearer, norms, and others’ thoughts (Table 8).

Table 8.

Meaning of "Socially Acceptable"

Category	Phrases
Others' reactions (8)	No reaction from others; no ridicule from others; not singled out in a crowd; neutral reaction from others; generally accepted by the vast majority of people; positive reaction from others; praise from others; opens possibilities with others (instead of closing off).
Qualities of the device or wearer (7)	Expect thing to be useful to community; lack of social acceptability when result is not paying attention to other person; not invasive (functions); not too expensive; not weird; unknown capabilities of device means questionable social acceptability; person who brings it to community is trustworthy/knowledgeable about technology.
Norms (6)	Agreed-upon mental state of group; common; conform to social norms within a community; norm; normal part of life; social norms you need to stick to.
Others' thoughts (5)	Majority agree with; majority deem OK in public; not judged negatively; not offended by it; people judge you favorably or don't judge you.

Q6: Does the Construct Make Sense?

This was followed by asking participants if they thought it makes sense to talk about the social acceptability of a wearable, because the WEAR Scale seeks to measure the construct as it is perceived by the target population. The results are tallied in Table 9 along with each participant's primary commentary.

The majority agreed that it makes sense to talk about the social acceptability of a wearable, with just one person saying no. This participant said that people should be able to "do what they want" and equated social acceptability with possessing the latest version of a device, which did not make sense to her, because older versions of a device (e.g., a cell phone) were socially acceptable to her.

Table 9.

"Social acceptability of a wearable" makes sense?

Category	Comments
Yes (6)	Absolutely, wearables have social implications; makes perfect sense because thinking how a new device will be accepted socially, it is risky for company; most people care a lot about their social impressions and how they are perceived by other people; can be the best device functionally but if no one wants to wear it, it's just a good product that can't be sold; makes sense for engineers, and also for friends to talk about; with every new tech it is good to have this discussion beforehand, want to know what's appropriate.
Depends/ Probably (2)	Makes sense for a company making wearables; more from a marketing point of view or if curious about rate of adoption.
No (1)	Does not make a lot of sense to me because not relevant to how I think.

Q7: Acceptable/Unacceptable Criteria

Prompted to describe what makes a wearable socially acceptable or unacceptable, participants responded with 20 concepts; half of these comments addressed social acceptability and half addressed lack of social acceptability. The categories that emerged for these concepts bore similarities to the categories used for Question 4 (important criteria when considering a wearable). Three of the categories from Question 4 – consequences, aesthetics, and functionality – were useful in categorizing responses to Question 7. However, an additional category of "available/ordinary" was identified, and in fact contained the largest number of responses.

Table 10.

Wearable criteria for social acceptability/unacceptability

Category	Criteria
Available/ Ordinary (7)	*Acceptable:* Accessible (affordable and not in limited release); with time it becomes acceptable *Unacceptable:* Exclusive (regarding price/availability); makes people who do not have it feel not good; too much media buzz; newness; showboating (show of status/tech-savvy).
Consequences (6)	*Acceptable:* Benefits society; helps people; user not rude. *Unacceptable:* Takes advantage of other people; makes people uncomfortable; user rude/not acting within social constraints.
Aesthetics (5)	*Acceptable:* Aesthetically pleasing; latest version; slightly hidden (not immediately visible); stylish. *Unacceptable:* Goofy.
Functionality (2)	*Acceptable:* Functions do not impede on others' "bubble." *Unacceptable:* Over-functionality.

Some participants reported that they found exclusivity, media buzz, and "show" to be socially unacceptable. Looking back to Question 3, the wearables most frequently mentioned with regard to familiarity were Google Glass and Apple Watch. The launches of these products were marked by limited availability and notable media coverage. For example, interest in Glass was intense when it was unveiled in 2012 (Bilton, 2015), as explained in the case study above. In fact, the interview results suggest that industry may be misguided in launching wearables that are of limited availability and marketed as out-of-the-ordinary.

Q8: Devices on Bodies

Participants were next asked why people might not want certain devices on their own and others' bodies. As with the prior question, the categories that emerged for these concepts bore similarities to the categories used for Question 4 (important criteria when considering a wearable). All five categories from Question 4 were utilized, and an additional one emerged

– judgment – a category that was also used for Question 1. The 23 reasons participants gave and the category to which those were assigned are shown in Table 11.

Table 11.

Why people do not want devices on their own and others' bodies

Category	Reasons
Consequences (9)	Cost; distracting when driving; don't want actions/words recorded; "sticky situation" with police; negative reaction from others; privacy issues (2); radiation issues; social stigma (e.g., Google Glass ban).
Ergonomics (6)	Comfort (restricts movement; interferes with clothing); encumbering; gets in your way; pacemaker concern; physical restrictions or not comfortable wearing something on their wrists; uncomfortable.
Judgment (4)	Not open-minded; status (puts wearer above others); symbolizes something undesirable; too reliant on technology.
Aesthetics (3)	Obvious; too visible/obvious/pretentious; ugly.
Functionality (1)	Lack of utility.

Q9-12: Reactions to Specific Wearables

For Questions 9 through 12, participants were presented an image of a wearable device, along with a description of the wearable (see Appendix C). Participants were asked whether they found the device acceptable to wear in public, whether they could imagine themselves wearing it, and how they would feel about seeing someone in a coffee shop wearing it. Responses are summarized in Figure 3. Reactions to four devices.

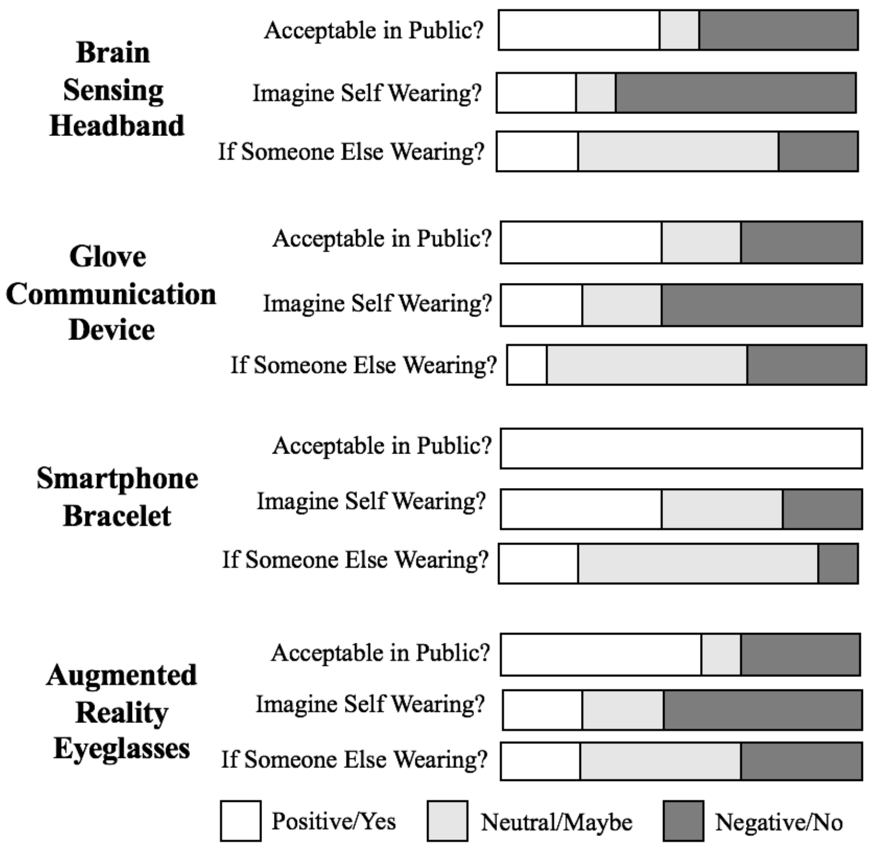


Figure 3. Reactions to four devices.

In terms of individual devices, the smartphone bracelet was deemed most acceptable overall. A number of participants noted its similarity to existing accessories or a smart phone, stating (for example) that they wouldn't even notice the device on someone. Participants were least likely to imagine themselves wearing the brain sensing headband. Comments suggest that this is because the headband is highly visible on the head, and also (unlike the augmented reality glasses) it does not resemble any existing accepted accessory or device.

Q13: Adoption Curve

With the wearable innovation like the ones just shown, participants were asked if they would like to be the first of their friends to have it, or if they would rather have their friends try it first. Six participants said friends. For the remaining three participants, the comments were: if cost not a factor he would try first; depends on cost; doesn't care.

Q14: Good Demonstrator

Participants expressed a variety of opinions when asked who would make a good demonstrator of a wearable (Table 12). One participant's response was included in all categories, because it contained components fitting in each.

The fact that this participant's response spanned all categories, and also the variety of others' responses, suggests that there is no consensus as to who would make a good demonstrator of a wearable. Rogers (2003) pointed out that interested parties may try to speed up the innovation-decision process by sponsoring demonstrations of an innovation, which can be quite effective if the demonstrator is an opinion leader. However, in the present data, some participants expressed that an average or neutral person would be more effective.

Table 12.

Good demonstrator of a wearable

Response	Comments
Knowledgeable person/critic (4)	Professor, someone knowledgeable, not a model; a hard critic (even if everyone says A+, critic might say C); person in tech field, not company, *Wired* magazine doing extended, real-life trial; people I believe are knowledgeable about technology like *Tech Crunch* (but also skeptical because they may get paid for it).
Celebrity/ model/ advertisement (4)	Celebrity, talk show host, Steve Jobs; attractive person, model; Taylor Swift (or most popular celebrity of moment), point is to get buy-in; ads by companies.
Average/neutral person (3)	Neutral, honest, not overzealous, mellow, realist, NPR or podcast or product review; not tech savvy, average person, older than target group, not hip or trendy, Barack Obama; unboxing videos, but maybe person got from company for free so cynical about it— person I know and trust would be most useful.

Q15: Fad Versus Lasting Style

Asked if they thought a wearable like the Apple Watch might be a fad, or if it could have lasting style, three participants thought it was a fad, might be a fad, or is a fad for now. Two participants weren't sure. The remaining four participants said they did not think it was a fad, with two of those explicitly stating that a wearable could have lasting style.

The final two stages of the innovation decision process are implementation followed by confirmation of this decision (Rogers, 2003). However, wearables may be more like fashion than innovation, and thus may deviate from this process. That is, the implementation and confirmation stages may be affected by users' perception of a wearable being a passing fad.

Q16: Relative Advantage

Seven participants agreed that a new wearable should offer an improvement over existing products. One participant said yes in terms of "morality" but no in terms of economic measures (i.e., industry's motivation is profit not beneficence, which is of dubious moral ground). Finally, one participant said no, stating that removing features and simplifying may actually be preferable. Relative advantage is one of the strongest predictors of adoption (Rogers, 2003), but may be less applicable to wearables than other innovations, because a wearable may be so novel that it is not perceived as improving upon any existing device.

Q17: Computer Versus Accessory

Asked whether a wearable is more like a computer or an accessory, five participants said accessory, while four said both, or it depends. If a wearable is viewed more as an accessory, Diffusion of Innovations theory (Rogers, 2003) may be less applicable, while theories of clothing and dress may be more applicable. Also, “categorization” may be a very important concept in explaining factors affecting wearable acceptability, in that how people categorize a wearable (e.g., as a cell phone or video camera or piece of jewelry) will have an influence on factors affecting social acceptability (inferred from Hamilton, 1979).

Q18: Other thoughts/comments

Five participants offered these further comments (paraphrased):

P1: Benefits and fashion both important, but for me it is perceived benefits first; looks nice is secondary – can stop me from buying, but will not buy for sake of fashion.

P2: For people with disabilities it’s great to have options, but no need to invent new things for no reason.

P3: The more socially acceptable, the more well designed and less intrusive; I would never wear the glove – would hamper other functionality and draw attention all day long.

P4: Wearables are unique in that they’re crossing some boundary; laptop to implants is range or spectrum; wearables are a step toward implants, becoming a part of us; ordering a pizza on a watch is more intimate than on a laptop, unique because of that; that’s why the social interaction is important -- super important topic; cell phone probably started with social stigmas, now OK to walk around texting, running into people, for the most part, socially acceptable – maybe that’s what’s to come for wearables.

P5: Computer moved to phone, now moving to third device (wearable); I think it will be a fad for general population but very useful for certain things like research; I do not think it will be fashionable or in public eye.

These results from Study 1 directly led to generation of WEAR Scale items, as reported in section 3.2. However, because it is important to formally define the construct prior to writing scale items, the definition of "social acceptability of a wearable" is considered next.

3.1.2 Definition of construct

Participants were first asked what the term "wearable" meant to them, and the majority of participants thought of a wearable as a physical object, either a generic or specific device, or more generally in terms of its physicality. Thus, the definition of the term "wearable" in this research will focus on this physical aspect.

In Question 3, participants were asked to talk about some wearables with which they were familiar. As they discussed various wearables, terms associated with positive feelings were novelty, curiosity, and/or usefulness. Terms associated with negative feelings were too much status, too much power, too many capabilities, ridiculousness, and skepticism/disillusionment. The negative feelings contain a stronger social component than the positive feelings; that is, novelty, curiosity, and usefulness are generally personal experiences, whereas feelings of "too much" and ridiculousness are in relation to one's social interactions. This suggests that social acceptability may best be defined as an absence of negative experiences rather than the presence of positive experiences, and this component is thus added to the construct definition.

In discussing the meaning of "socially acceptable" in Question 5, the greatest number of comments focused on other peoples' reactions and thoughts. Again, absence of negative responses or judgments predominated, e.g., no reaction or ridicule from others, not singled out in a crowd, not judged negatively, and not offended by it.

Therefore, combining the above qualitative data with definitions found in the literature (Dunne, Profita, Zeagler, Clawson, Gilliland, Do, & Budd, 2014; Goffman, 1990; Introduction to wearable technology, 2014; Mann, 2014; Lum, Sims, Chin, & Lagattuta, 2009; Rico & Brewster, 2010), the resulting definition of the construct “social acceptability of a wearable device” is as follows:

A wearable, for the purposes of developing the WEAR Scale, is a small computational device or accessory that is worn on the body in public. A wearable is personal, and personally-owned, and is at least minimally visible and comfortable. Donning a wearable requires action, which is preceded by decision-making about the social acceptability of the action and the anticipated reaction of others. A socially acceptable wearable is most notably marked by an absence of negative reactions or judgments from others.

This definition fulfills Step 1 in Table 1, *determine what is being measured*. It guides item generation and was provided to the experts performing the review of the initial item pool (v.1) in Study 2.

3.1.3 Argument for content validity

An objective of the present study was to establish an argument for content validity from the data. DeVellis (2012) asserted that achieving appropriate content validity requires that a specific set of items sufficiently reflects a domain of content. Methods do exist to maximize item appropriateness, and are implemented herein – interviewing the target population (Study 1) and expert review (Study 2). Such methods make up an item development study, which is the basis of an argument for content validity (DeVellis, 2012; DeWalt, Rothrock, Yount, & Stone, 2007; Sterba et al., 2007).

3.2 Determine Scale Format and Compose Item Pool

3.2.1 Methods

Beginning with an item pool that is three or four times the length of the final scale is common (DeVellis, 2012). Because the construct "social acceptability of a wearable device" is not derived from a single existing theory, and because it stems from a multitude of literatures, the final WEAR Scale is expected to be about 20 items in length. Therefore, 60 to 80 items were the guideline for the minimum initial pool. The goal at this stage should be "simply to identify a wide variety of ways that the central concept of the intended instrument can be stated" (DeVellis, 2012, p. 81).

Good items are clear, unambiguous, contain a single idea, and are not overly long or wordy; reading difficulty level should be taken into account (Devellis, 2012; Spector, 1992). The researcher must make a decision whether to make some items negatively worded. If all items are positively worded, acquiescence or agreement bias may result. Negatively-worded items were included herein when they could be concise and clear, and reflected the construct in way than was better than a positively-worded item. Agreement response anchors are versatile and popular, with 5 to 9 choices optimal (Spector, 1992) and were used here. The response choices for each item were: Strongly Agree (6), Agree (5), Somewhat Agree (4), Somewhat Disagree (3), Disagree (2), and Strongly Disagree (1). Pilot testing was conducted to assess whether any items were ambiguous or confusing (Dillman, Smyth, & Christian, 2014; Spector, 1992), which occurred via expert review (Study 2) as well as prior to administration in Study 3.

Each item was written to reflect the construct "social acceptability of a wearable device." Redundancy in items has both its pros and cons; while the final instrument should aim to lessen redundancy, it can make sense in the initial item pool. Of course, irrelevant redundancies should be avoided, i.e., those pertaining to incidental vocabulary and grammar (DeVellis, 2012).

One thing to consider with Likert scales is that overly mild statements might elicit too much agreement. The researcher should imagine how individuals from the target population with different strengths of the attribute or attitude in question are likely to respond. A measure among respondents cannot co-vary if it does not vary, therefore, items should be written so that variation among respondents is a reasonable expectation. Similarly, the number of response choices should be sufficient to allow for variation (i.e., six or seven)—but not so numerous that differences between response choices become meaningless (DeVellis, 2012). Therefore, the WEAR Scale will consist of statements in which participants will respond to their level of agreement on a scale of 1 to 6. The author avoided a neutral middle choice to elicit a more thoughtful response from participants.

A number of questions in the interview study resulted in concepts that were then categorized. These concepts and categories were a useful starting point in organizing the writing of scale items. Question 7, *What makes such a wearable socially acceptable or unacceptable?*, most directly addresses the construct, and therefore it is the starting point for item generation (Table 13). Four categories were identified in the responses to Question 7: available/ordinary; consequences; aesthetics; and functionality. Items that represent lack of social acceptability are followed by an "(R)" to designate reverse coding. Note that some of these items may be largely factual (i.e., whether wearable is or is not in limited release); however, it still makes sense to ask people's perception of such facts.

Table 13.

Items Derived from Wearable Criteria for Social Acceptability/Unacceptability

Category	Item
Available/ Ordinary	1. This device seems to be accessible, that is, affordable and not in limited release.
	2. This device has been around for a while.
	3. This device seems exclusive. (R)
	4. People who do not own this device may not feel good around a person wearing it. (R)
	5. There has been a lot of media buzz about this device. (R)
	6. This device is very new. (R)
	7. Wearing this device would be a show of status or tech-savvy. (R)
Consequences	8. This device could benefit society.
	9. This device could help people.
	10. Wearing this device would not be rude.
	11. This device could allow its wearer to take advantage of people. (R)
	12. This device could make people uncomfortable. (R)
	13. The wearer of this device could be considered rude or not acting within social constraints. (R)
Aesthetics	14. This device is aesthetically pleasing.
	15. This device seems like "the latest version."
	16. On the wearer, this device would be slightly hidden, or not immediately visible.
	17. This device is stylish.
	18. This device is goofy. (R)
Functionality	19. The functions of this device would not impede on another person's "bubble."
	20. This device has too many functions. (R)

Secondly, Question 5, *What does "socially acceptable" mean?*, is very relevant to item generation. Items derived from Question 5 results are shown in Table 14 below.

Table 14.

Items Derived from Meaning of "Socially Acceptable"

Category	Item
Others' reactions	21. Wearing this device would elicit no reaction from other people.
	22. There is no chance of being ridiculed when wearing this device.
	23. The wearer of this device would not be singled out in a crowd.

Table 14. continued

Category	Item
	24. Wearing this device would elicit a neutral reaction from other people. 25. This device would be generally accepted by the vast majority of people. 26. The wearer of this device would get a positive reaction from others. 27. The wearer of this device would get praise from others. 28. Wearing this device would open possibilities with other people (instead of closing off possibilities with other people).
Qualities of the device or wearer	29. I expect this device would be useful to the community. 30. This device could result in its wearer not paying attention to other people (R). 31. The functions of this device do not seem to be invasive. 32. This device seems not too expensive. 33. This device is not weird. 34. This device has unknown capabilities. 35. A person wearing this device is probably trustworthy and/or knowledgeable about technology.
Others' thoughts	36. The majority of people would probably agree this device is OK to wear. 37. The majority of people probably think this device is OK to wear in public. 38. The wearer of this device would not be judged negatively by others. 39. People would not be offended by the wearing of this device. 40. If you wore this device, people would judge you favorably, or wouldn't judge you at all.
Norms	41. This device seems fairly common. 42. This device would conform to the social norms within my community. 43. This device is just part of the norm. 44. This device could be considered a normal part of life. 45. A wearer of this device would be keeping to the social norms we need to stick to.

The responses to Questions 5 and 7 of the interview study, therefore, resulted in concepts that were sorted into eight unique categories as displayed in Table 13 and Table 14. Other questions provided further insight into potential item generation, and also had considerable redundancy with the items generated above. Disregarding duplicative concepts, as well as concepts not sensibly related to the construct, Table 15 and 16 provide further item generation from interview question 4 (What are the important criteria when considering a wearable?) and question 8 (Why do people not want certain devices on their own and others' bodies?).

Table 15.

Items Derived from Important Criteria When Considering a Wearable

Category	Item
Functionality	46. This device seems to be useful and easy to use.
Consequences	47. This device provides more benefits than distractions.
	48. This device would "cost" society. (R)
	49. This device would have a positive effect on the social world.
Aesthetics	50. This device can be either casual or formal.
	51. This device is fashionable.
	52. This device sleek, not clunky.
	53. This device is my kind of style.
	54. This device could trend.
Ergonomics	55. This device seems comfortable, not bulky.
	56. This device would physically get in the way. (R)
	57. The size of this device is conveniently small.

Table 16.

Items Derived from Why People Do Not Want Devices on Body

Category	Item
Consequences	58. This device would be distracting when driving. (R)
	59. Use of this device raises privacy issues. (R)
	60. Use of this device could be socially stigmatizing. (R)
Ergonomics	61. This device might restrict movement or interfere with clothing. (R)
	62. This device could cause health concerns. (R)
Judgment	63. This device puts the wearer above others in terms of status. (R)
	64. This device symbolizes something undesirable. (R)
	65. This device makes us too reliant on technology. (R)
	66. This device is pretentious. (R)
Aesthetics	67. This device is too obvious. (R)
	68. This device is ugly. (R)

Ten categories, then, resulted from analyzing these interview questions: aesthetics, available/ordinary, consequences, ergonomics, functionality, judgment, norms, others' reactions, others' thoughts, and qualities of the device or wearer.

Next, the concepts in the literature as identified in Appendix A (*Concepts from Literature Considered in Item Generation)* were examined as to whether the concepts were represented in the above 68 items. Table 17 considers each concept from the literature and states either 1) the existing item from the interviews that addresses that concept or 2) the new item number written for the concept, because it was not found in the interview.

Table 17.

Concepts from Literature and Relation to Current Items or New Item

Reference	Concept No. and Concept	Addressed by current item or by creating new item
Adam & Galinsky, 2012	1 - Wearing clothes causes people to embody not just the clothes but also the clothing's symbolic meaning. The two independent factors of enclothed cognition—the symbolic meaning of the clothes and the physical experience of wearing them—have significant and systematic psychological and behavioral consequences for their wearers.	No. 64 addressed symbolism; consequences are addressed by items in the categories of Consequences, Others' Reactions, and Others' Thoughts.
Banister & Hogg, 2004	2 - People will purposely avoid or reject a product if it is associated with negative symbolic meanings	No. 64 addressed symbolism.
Baraniuk, 2015	3 - A wearable will have social barriers if it is: disruptive in a negative sense; annoying; disturbing to social norms; adds confusion to conventional human interaction.	Social norms are addressed by the Norms category; disruption addressed by e.g., No. 30; annoyance and confusion addressed in new No. 69.
Byrne, 1971; Davis, L.L., 1984	4- When we perceive others as being similar to ourselves, our own attitudes and behaviors are confirmed, and thus we are more attracted to similar others; attraction to others, or lack thereof, affects further interaction.	Addressed in new No. 70.
Cellan-Jones, 2015; Editorial Board, 2015; Garfinkel, 2015	5 - "Creepy" was a recurring descriptor of Google Glass as it made its way into public consciousness. Creepy has negative connotations that range from mild (unpleasantness) to moderate (unease) to severe (fear).	Addressed in new No. 71.
Cunningham & Voso, 1991	6 - "Clothing helps to define our identity by supplying cues and symbols that assist us in categorizing within the culture" (p. 11).	Addressed in new No. 72.

Table 17. continued

Reference	Concept No. and Concept	Addressed by current item or by creating new item
Damhorst, 1984-85; Kaiser, 1997; Rees, Williams, & Giles, 1974	7 - Clothing has been shown to be a form of nonverbal communication, with the message being dependent on the social context.	Addressed in new No. 73.
Davis & Lennon, 1988 (derived from)	8 - Individuals may attribute certain causes or characteristics to the user (whether another person or themselves) based on wearing the device.	Addressed in new Nos. 70, 72, 73.
Davis, F., 1992	9 - Dress can work as “a kind of visual metaphor for identity” (p. 139).	Addressed in new Nos. 70, 72, 73.
Davis, F.D., 1989	10 - Davis's perceived usefulness construct may need to be restructured: is wearable's usefulness socially acceptable?	Addressed by items in the Consequences category.
Davis, L.L. 1984	11 - Appearance and clothing give rise to certain behavioral or judgmental responses in the viewer, and thus are a form of nonverbal communication.	Addressed by new No. 73 and also by items in the categories of Consequences, Others’ Reactions, and Others’ Thoughts.
Dunne, Profita, Zeagler, Clawson, Gilliland, Do, and Budd, 2014; Profita, Clawson, Gilliland, Zeagler, Starner, Budd, & Do, 2013	12 - The qualitative analysis (2014) found that the wrist and forearm were preferred bodily placements due to reasons of usability and avoiding social discomfort. Participants expressed concerns about less favorable bodily locations for wearables as the desire to avoid feelings of awkwardness or embarrassment. The most important feature for a wearable in the United States was ease of operation, while in South Korea it was minimizing an awkward appearance.	Similar to No 12; further addressed by new No. 74.
Editorial Board, 2015	13 - Google Glass did not clearly solve any problems but did pose potential risks to privacy, anonymity, and self-respect.	Similar to No 47; further addressed by New Nos. 75 and 76.
Editorial Board, 2015	14 - Innovations require the public’s interest and consent; collectively we weigh an innovation’s benefits versus costs.	Similar to No 47; further addressed by New Nos. 75 and 77.
Entwistle, 2000	15 - Numerous factors structure dress in the West, including fashion, sex, class, income, and tradition.	Addressed by items in Norms category; addressed by New No. 78.
Entwistle, 2000	16 - “Clothes and other bodily adornments are part of the vocabulary with which humans invent themselves, come to understand others and enter into meaningful relationships with them” (p. 182).	
Entwistle, 2000	17 - A person who dresses inappropriately for his or her culture is “subversive of the most basic social codes and risk[s] exclusion, scorn or ridicule.” (p. 7)	Similar to items in categories of Others’ Reactions and Norms; addressed by New No. 79.

Table 17. continued

Reference	Concept No. and Concept	Addressed by current item or by creating new item
Entwistle, 2000	18 - Fashion goes on the body, in public display, and is a way to fix identity, if only temporarily.	Addressed by new category Self-Identity.
Fortunati, Katz & Riccini, 2003	19 - Respect is an aspect of the body that must be kept safe, because it is closely associated with individual identity.	Addressed by new item No. 76.
Fortunati, Katz & Riccini, 2003	20 - Wearables are about the integration of the human body with technology, which is a topic that generates both anxiety and delight.	Similar to No. 12; addressed by new item no. 80.
Fortunati, Katz & Riccini, 2003	21 - The body represents the maximum level of "naturalness" possible, at a time when the artificial is extending its dominion over the natural.	Addressed by new item No. 81.
Fortunati, Katz & Riccini, 2003	22 - The body expresses who we are, what we have been, and who we would like to be.	Addressed by new category Self-Identity; addressed by new item No. 82.
Fortunati, Katz & Riccini, 2003	23 - Pairing the body with technology is both exciting and threatening.	Similar to items Nos. 12 and 80; addressed by new item No. 83.
Gibbons & Gwynn, 1975 (inferred from)	24 - Presumably if a wearable is consistent with a person's self-image, that person will find it acceptable. If it is not, this lowers the probability of acceptance, especially for fashion-savvy individuals.	Addressed by new category Self-Identity; addressed by new item No. 84.
Goffman, 1990	25 - Actions may be carried out (such as wearing a device), with observers' reactions serving as feedback on the social acceptability of the action.	Addressed by items in Others' Reactions category.
Haque, 2015	26 - Cool is associated with social acceptability.	Addressed by new item No. 85.
Johnson, Yoo, Kim & Lennon, 2008	27 - Dress plays a role in the establishment of personal identities.	Addressed by new category Self-Identity..
Johnson, Yoo, Kim & Lennon, 2008	28 - Dress serves as a communication tool with others.	Addressed by new item No. 73.
Katz, Aakhus, Kim, & Turner, 2003	29 - Fashion is a "second skin" projects to others how they should engage with the wearer (p. 75).	Addressed by new item No. 73.
Lum, Sims, Chin, & Lagattut, 2009 (inferred from)	30 - Wearables can be more impactful than clothing in the social realm in that wearables may interrupt or modify interpersonal communication as well as provide the user with capabilities like video recording.	Addressed by items in the categories of Consequences, Functionality, and Norms.

Table 17. continued

Reference	Concept No. and Concept	Addressed by current item or by creating new item
Lum, Sims, Chin, & Lagattut, 2009; Manoj & Azariah, 2001	31 - Even though we are a technology-driven society, persons wearing technology may be perceived as less human-like, and there has been and continues to be a negative stigma attached to the excessive use of technology.	Similar to item Nos. 60 and 67; addressed by new item No. 86.
Lum, Sims, Chin, & Lagattuta, 2009	32 - A wearable may make a person look threatening.	Addressed by new item No. 83.
Lum, Sims, Chin, & Lagattuta, 2009	33 - Individuals may perceive others more positively when they adhere to expectations for what people naturally look like.	Similar to new item No. 81, “and how people look” added to end.
McAtamney & Parker, 2006	34 - A wearable may interfere with interpersonal relations.	Addressed by items in Consequences category.
Moore & Benbasat, 1991	35 - Image, “the degree to which use of an innovation is perceived to enhance one’s image or status in one’s social system” (p. 195), relates to social acceptability.	Addressed by new category Self-Identity; addressed by new item No. 87.
Ogle, Tyner, & Schofield-Tomschin, 2013	36 - The choices available for a certain wearable may not allow people to express their true selves, and in fact symbolize someone they do not want to associate with.	Addressed by new category Self-Identity also item No. 64.
Oksman & Rautiainen, 2003 (inferred from)	37 - As technology becomes more mobile and more wearable, we will increasingly perceive it be an extension of our body, and identity.	Addressed by new category Self-Identity.
Pogue, 2013	38 - The biggest obstacles for social acceptance are the smugness of people who wear Glass and the discomfort of people who don’t wear Glass.	Addressed by item Nos. 12 and 66.
Rico & Brewster, 2010	39 - Putting on a wearable can be viewed as a performance, “an intentional action executed by an individual with the awareness of spectators” (p. 888).	Addressed by item in categories Others’ Reactions and Others’ Thoughts.
Rogers, 2003	40 - Interested parties may try to speed up the innovation-decision process by sponsoring demonstrations of an innovation, which can be quite effective, especially if the demonstrator is an opinion leader.	Addressed by item No. 35.
Rogers, 2003	41 - Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters, and is closely aligned with acceptability research.	Touched on by other items; directly addressed in new item No. 88.
Rogers, 2003	42 - Complexity is the degree an innovation is perceived as relatively difficult to understand and use, and the generalization is that it is negatively related to rate of adoption.	Addressed by item Nos. 20 and 46.

Table 17. continued

Reference	Concept No. and Concept	Addressed by current item or by creating new item
Rogers, 2003	43 - Trialability is generally positively related to rate of adoption.	Tangentially related to social acceptance, as addressed by item Nos. 1 and 3.
Rogers, 2003 (inferred from)	44 - Initial knowledge about a wearable is a factor affecting acceptability, which consequently affects the formation of attitudes toward the innovation.	Addressed by new item No. 89.
Rogers, 2003 (inferred from)	45 - A person's feelings and attitudes about acceptability of a wearable would be more strongly influenced by peers rather than mass media.	Addressed by items in categories of Others' Reactions and Others' Thoughts; peers specifically addressed by new item No. 90.
Rogers, 2003 (inferred from)	46 - A wearable may be more socially acceptable is it displays Relative Advantage—is perceived as being better than the idea it supersedes.	Addressed by new item No. 91.
Rogers, 2003 (inferred from)	47 - How people perceive existing ideas in the same category of the wearable likely affects acceptability.	Addressed by new item No. 92.
Segrave, 2011	48 - Glasses have been perceived as disfiguring to and a social handicap for women and girls.	Social handicap addressed by e.g., item No. 60; disfigurement addressed by new item No. 93.
Segrave, 2011	49 - Eyeglasses have been criticized as obtrusive, heavy, aggressive, ridiculous, and a result of inane foreign influence.	Generally addressed by e.g., item nos. 22, 52, 55, and 56.
Segrave, 2011 (inferred from)	50 - Some wearable technologies have forms very similar to worn objects that have been an accepted part of Western culture for decades, such as wristwatches, or centuries, such as eyeglasses.	Addressed by new item No. 92.
Swan, 2012	51 - If the EEG rig were designed to be sufficiently comfortable, unobtrusive, and visually-attractive, it could be worn 24/7.	Generally addressed by item No. 55 and other items in Ergonomics and Aesthetics category.
Taylor, Fiske, Etcoff, & Ruderman, 1978 (inferred from)	52 - Variables that have been shown to be significant in stereotyping, such as race, sex, social status, body type, physical attractiveness, and age, may also play a role in the social acceptability of wearables; a certain wearable may display membership to a certain social group	Addressed by new item No. 94.
Tene & Polonetsky, 2013	53 - Technology is creepy when it uses data in a new way or removes obscurity, but without breeching law or causing harm.	Addressed by new item No. 71.

Table 17. continued

Reference	Concept No. and Concept	Addressed by current item or by creating new item
Tene & Polonetsky, 2013	54 - The term “creepiness” derives from the failure of individuals and industry to adjust their actions when using new technologies, resulting in a misalignment with current social norms.	Addressed by the Norms Category and also new item No. 71.
Tene & Polonetsky, 2013	55 - Businesses should be open and transparent about their data practices, purposes, and needs.	Addressed by item No. 59 and new item No. 76.
Tene & Polonetsky, 2013 (inferred from)	56 - The more a wearable’s functions raise privacy concerns, the less socially acceptable it will be.	Addressed by item No. 59 and new item No. 76.
Wasik, 2014	57 - Phil Libin, CEO of Evernote, thinks that wearables will make human beings smarter—more aware, more mindful, less confused, and feeling part of a connected universe.	Addressed by e.g., item Nos. 47 and 69, and new item No. 95.
Wasik, 2014	58 - Wearables present a unique challenge: to create something beautiful and functional and personal.	Addressed by items in various categories – Aesthetics, Functions, and Consequences, and the new category of self-identity.
Wasik, 2014	59 - Robert Brunner, offered this explanation as to why technology and fashion tend to be at odds: the early adopters of technology do not necessarily provide the “aspirational dynamic” that would typically push fashion products into the mainstream (p. 99).	Addressed by new item No. 96.
Wasik, 2014	60 - To be fashionable, a wearable needs to convey a message the wearer is happy to send.	Addressed by new item No. 73.
Wasik, 2014	61 - To be fashionable, a wearable cannot be the same for and worn by "everyone".	Addressed by new item No. 97.

The new items identified in the last column of the above table are presented in Table 18.

Table 18.

Additional Items Derived From Literature

Category	Item
Consequences	69. This device seems like it would be annoying or add confusion to the typical interactions of people. (R)
Self-identity	70. If I saw someone wearing this device, I would think, *that is person like me*.
Judgment	71. This device seems creepy. (R)
Self-identity	72. This device helps to define the wearer's identity in a positive way.
Self-identity	73. I like what this device communicates about its wearer.
Consequences	74. This device's placement on the body could cause awkwardness or embarrassment. (R)
Consequences	75. This device does not seem to solve any problems, but does pose potential risks. (R)
Consequences	76. This device poses risks to the wearer's privacy, anonymity, or self-respect. (R)
Norms	77. I can imagine that people would be interested in this device and would not have a problem wearing it.
Norms	78. This device is like the clothing and accessories typically worn in our society.
Norms	79. Wearing this device could be considered inappropriate. (R)
Consequences	80. Use of this device would create more joy than anxiety.
Ergonomics	81. This device has a natural fit with the body and how people look.
Self-identity	82. This device positively expresses who we are, what we have been, and who we would like to be.
Consequences	83. Use of this device would be more threatening than exciting. (R)
Self-identity	84. This device is consistent with my self-image.
Judgment	85. This device is cool.
Judgment	86. This device seems like "too much" technology. (R)
Self-identity	87. This device would enhance the wearer's image.
Judgment	88. This device is generally consistent with my past experiences, and existing values and needs.
Judgment	89. My initial knowledge of this device has made a positive impression.
Others' thoughts	90. I think my peers would find this device acceptable to wear.

Table 18. continued

Category	Item
Qualities of the device or wearer	91. This device seems to be an improvement over what has come before.
Available/ Ordinary	92. This device is similar to existing acceptable devices or accessories.
Aesthetics	93. This device might be considered disfiguring to its wearer. (R)
Self-identity	94. The way this device displays membership to a certain social group is unappealing. (R)
Consequences	95. It seems this device could make people smarter.
Self-identity	96. I could imagine aspiring to be like the wearer of such a device.
Aesthetics	97. This device seems to offer options for personalization, so that everyone is not wearing the "same thing."

A new category emerged from concepts found in the literature: self-identity. This is a concept that did not present in the interview data, but is added as a category due to its importance in the literature. Therefore, eleven categories were identified by categorizing the concepts found in the literature and interviews: Aesthetics; Available/Ordinary; Consequences; Ergonomics; Functionality; Judgment; Norms; Others' Reactions; Others' Thoughts; Qualities of the Device or Wearer; and Self-identity.

Next, items in each category were combined from the literature and interviews, and examined for redundancies. The author sought to delete redundant items prior to providing the pool to experts for review. For Study 3, the pool could reasonably consist of about 50 items, and it was anticipated that the expert review would allow the winnowing of about 20 items. The item pool size desired for expert review was judged to be about 70 items; therefore, the goal was to remove about 25 percent of the 97 items from each category to arrive at about 70 items for expert review.

As specified below, the items in each category were examined for redundancy, resulting in about 25% being deleted. Retained items are bolded. Deleted items are unbolded, and a brief explanation of their selection for deletion is provided.

Aesthetics (14 items; remove 3 or 4)

14. This device is aesthetically pleasing.
15. This device seems like "the latest version."
16. On the wearer, this device would be slightly hidden, or not immediately visible. – Deleted because it is quite similar to 67, but less economical.
17. This device is stylish.
18. This device is goofy. (R)
50. This device can be either casual or formal.
51. This device is fashionable.
52. This device sleek, not clunky.
53. This device is my kind of style. –Deleted because redundant with 17.
54. This device could trend.
67. This device is too obvious. (R)
68. This device is ugly. (R) – Deleted because if it is aesthetically pleasing (see no. 14), it is not ugly.
93. This device might be considered disfiguring to its wearer. (R)
97. This device seems to offer options for personalization, so that everyone is not wearing the "same thing."

Available/Ordinary (8 items; remove 2)

1. This device seems to be accessible, that is, affordable and not in limited release.
2. This device has been around for a while. –Deleted because redundant with 6.
3. This device seems exclusive. (R) –Deleted because redundant with 1.
4. People who do not own this device may not feel good around a person wearing it. (R)
5. There has been a lot of media buzz about this device. (R)
6. This device is very new. (R)
7. Wearing this device would be a show of status or tech-savvy. (R)
92. This device is similar to existing acceptable devices or accessories.

Consequences (19 items; remove 4 or 5)

8. This device could benefit society. –Deleted because redundant with 9 and 48.
9. This device could help people.
10. Wearing this device would not be rude. –Deleted because similar to 13.
11. This device could allow its wearer to take advantage of people. (R)
12. This device could make people uncomfortable. (R)
13. The wearer of this device could be considered rude or not acting within social constraints. (R)
47. This device provides more benefits than distractions. –Deleted because covered more specifically in a number of items.
48. This device would "cost" society. (R)

49. This device would have a positive effect on the social world.
58. This device would be distracting when driving. (R)
59. Use of this device raises privacy issues. (R)
60. Use of this device could be socially stigmatizing. (R)
69. This device seems like it would be annoying or add confusion to the typical interactions of people. (R)
74. This device's placement on the body could cause awkwardness or embarrassment. (R)
75. This device does not seem to solve any problems, but does pose potential risks. (R)
76. This device poses risks to the wearer's privacy, anonymity, or self-respect. (R) –Deleted because overlaps with 59 and 75.
80. Use of this device would create more joy than anxiety.
83. Use of this device would be more threatening than exciting. (R)
95. It seems this device could make people smarter.

Ergonomics (6 items; remove 1 or 2)
55. This device seems comfortable, not bulky.
56. This device would physically get in the way. (R) –Revise: This device might restrict movement or physically get in the way. (R)
57. The size of this device is conveniently small.
61. This device might restrict movement or interfere with clothing. (R) –Deleted because redundant with 56 (revised to include additional concept).
62. This device could cause health concerns. (R)
81. This device has a natural fit with the body and how people look.

Functionality (3 items; remove 0 or 1)
19. The functions of this device would not impede on another person's "bubble." –Deleted because addressed by items on Consequences category.
20. This device has too many functions. (R)
46. This device seems to be useful and easy to use.

Judgment (9 items; remove 2 or 3)
63. This device puts the wearer above others in terms of status. (R)
64. This device symbolizes something undesirable. (R)
65. This device makes us too reliant on technology. (R) –Deleted because similar to 86.
66. This device is pretentious. (R) –Deleted because similar to 63, and readers may not know meaning of pretentious.
71. This device seems creepy. (R)
85. This device is cool.
86. This device seems like "too much" technology. (R)
88. This device is generally consistent with my past experiences, and existing values and needs. –Deleted because may be too broad for reader to answer accurately.
89. My initial knowledge of this device has made a positive impression.

Norms (8 items; remove 2)
41. This device seems fairly common.

42. This device would conform to the social norms within my community. –Deleted because similar to 45.
43. This device is just part of the norm. –Deleted because similar to 44 and 45.
44. This device could be considered a normal part of life.
45. A wearer of this device would be keeping to the social norms we need to stick to.
77. I can imagine that people would be interested in this device and would not have a problem wearing it.
78. This device is like the clothing and accessories typically worn in our society.
79. Wearing this device could be considered inappropriate. (R)

Others' Reactions (8 items; remove 2)
21. Wearing this device would elicit no reaction or a neutral reaction from other people.
22. There is no chance of being ridiculed when wearing this device.
23. The wearer of this device would not be singled out in a crowd.
24. Wearing this device would elicit a neutral reaction from other people. –Deleted because similar to 21; edit 21 to add "or a neutral reaction"
25. This device would be generally accepted by the vast majority of people.
26. The wearer of this device would get a positive reaction from others.
27. The wearer of this device would get praise from others. –Deleted because redundant with 26.
28. Wearing this device would open possibilities with other people (instead of closing off possibilities with other people).

Others' Thoughts (6 items; remove 1or 2)
36. The majority of people would probably agree this device is OK to wear. –Deleted because redundant with 37.
37. The majority of people probably think this device is OK to wear in public.
38. The wearer of this device would not be judged negatively by others.
39. People would not be offended by the wearing of this device.
40. If you wore this device, people would judge you favorably, or wouldn't judge you at all. –Deleted because similar to 38.
90. I think my peers would find this device acceptable to wear.

Qualities of the Device or Wearer (8 items; remove 2)
29. I expect this device would be useful to the community. –Deleted because similar to 9 and 48.
30. This device could result in its wearer not paying attention to other people (R).
31. The functions of this device do not seem to be invasive.
32. This device seems not too expensive. –Deleted because similar to 1.
33. This device is not weird.
34. This device has unknown capabilities. (R)
35. A person wearing this device is probably trustworthy and/or knowledgeable about technology.
91. This device seems to be an improvement over what has come before.

Self-identity (8 items; remove 2)

70. If I saw someone wearing this device, I would think, *that is person like me*.

72. This device helps to define the wearer's identity in a positive way. –Deleted because similar to 73.

73. I like what this device communicates about its wearer.

82. This device positively expresses who we are, what we have been, and who we would like to be. –Deleted because too vague.

84. This device is consistent with my self-image.

87. This device would enhance the wearer's image.

94. The way this device displays membership to a certain social group is unappealing. (R)

96. I could imagine aspiring to be like the wearer of such a device.

3.2.2 Results (Initial Item Pool v.1)

Using the methodology described above, the 97 items in the pool created from the interviews and literature were culled based on redundancy, resulting in the 73 items for expert review (see below). The first number is the original number, and the last number in parenthesis is the new number used for the expert review.

14. This device is aesthetically pleasing. (1)
15. This device seems like "the latest version." (2)
17. This device is stylish. (3)
18. This device is goofy. (R) (4)
50. This device can be either casual or formal. (5)
51. This device is fashionable. (6)
52. This device is sleek, not clunky. (7)
54. This device could trend. (8)
67. This device is too obvious. (R) (9)
93. This device might be considered disfiguring to its wearer. (R) (10)
97. This device seems to offer options for personalization, so that everyone is not wearing the "same thing." (11)
1. This device seems to be accessible, that is, affordable and not in limited release. (12)
4. People who do not own this device may not feel good around a person wearing it. (R) (13)
5. There has been a lot of media buzz about this device. (R) (14)
6. This device is very new. (R) (15)
7. Wearing this device would be a show of status or tech-savvy. (R) (16)
92. This device is similar to existing acceptable devices or accessories. (17)
9. This device could help people. (18)
11. This device could allow its wearer to take advantage of people. (R) (19)
12. This device could make people uncomfortable. (R) (20)
13. The wearer of this device could be considered rude or not acting within social

constraints. (R) (21)

48. This device would "cost" society. (R) (22)
49. This device would have a positive effect on the social world. (23)
58. This device would be distracting when driving. (R) (24)
59. Use of this device raises privacy issues. (R) (25)
60. Use of this device could be socially stigmatizing. (R) (26)
69. This device seems like it would be annoying or add confusion to the typical interactions of people. (R) (27)
74. This device's placement on the body could cause awkwardness or embarrassment. (R) (28)
75. This device does not seem to solve any problems, but does pose potential risks. (R) (29)
80. Use of this device would create more joy than anxiety. (30)
83. Use of this device would be more threatening than exciting. (R) (31)
95. It seems this device could make people smarter. (32)
55. This device seems comfortable, not bulky. (33)
56. This device might restrict movement or physically get in the way. (R) (34)
57. The size of this device is conveniently small. (35)
62. This device could cause health concerns. (R) (36)
81. This device has a natural fit with the body and how people look. (37)
20. This device has too many functions. (R) (38)
46. This device seems to be useful and easy to use. (39)
63. This device puts the wearer above others in terms of status. (R) (40)
64. This device symbolizes something undesirable. (R) (41)
71. This device seems creepy. (R) (42)
85. This device is cool. (43)
86. This device seems like "too much" technology. (R) (44)
89. My initial knowledge of this device has made a positive impression. (45)
41. This device seems fairly common. (46)
44. This device could be considered a normal part of life. (47)
45. A wearer of this device would be keeping to the social norms we need to stick to. (48)
77. I can imagine that people would be interested in this device and would not have a problem wearing it. (49)
78. This device is like the clothing and accessories typically worn in our society. (50)
79. Wearing this device could be considered inappropriate. (R) (51)
21. Wearing this device would elicit no reaction or a neutral reaction from other people. (52)
22. There is no chance of being ridiculed when wearing this device. (53)
23. The wearer of this device would not be singled out in a crowd. (54)
25. This device would be generally accepted by the vast majority of people. (55)
26. The wearer of this device would get a positive reaction from others. (56)
28. Wearing this device would open possibilities with other people (instead of closing off possibilities with other people). (57)
37. The majority of people probably think this device is OK to wear in public. (58)
38. The wearer of this device would not be judged negatively by others. (59)
39. People would not be offended by the wearing of this device. (60)
90. I think my peers would find this device acceptable to wear. (61)
30. This device could result in its wearer not paying attention to other people (R). (62)

31. The functions of this device do not seem to be invasive. (63)
33. This device is not weird. (64)
34. This device has unknown capabilities. (R) (65)
35. A person wearing this device is probably trustworthy and/or knowledgeable about technology. (66)
91. This device seems to be an improvement over what has come before. (67)
70. If I saw someone wearing this device, I would think, *that is person like me*. (68)
73. I like what this device communicates about its wearer. (69)
84. This device is consistent with my self-image. (70)
87. This device would enhance the wearer's image. (71)
94. The way this device displays membership to a certain social group is unappealing. (R) (72)
96. I could imagine aspiring to be like the wearer of such a device. (73)

In conclusion, in Study 1 and related development, the process for determining what will be measured by the WEAR Scale was accomplished via a qualitative analysis of the literature review, followed by an interview study of the intended population. This resulted in a definition of the construct*, social acceptability of a wearable,* and also established an argument for content validity. The process for determining the scale format was explained, and the item pool was composed from the literature review data and interview study data, resulting in the 73 items for Initial Item Pool v.1. Next, these items will be subject to expert review and further scale development processes.

CHAPTER 4

STUDY 2 AND RELATED DEVELOPMENT

The next stage of scale development, according to DeVellis (2012), is to have a few people who are knowledgeable about the content area to review the item pool. Given the development of WEAR v.1 in Chapter 3, this chapter describes the process of expert review. This process was then followed by selecting items or scales for validation purposes, which was used in Study 3.

4.1 Expert Review of Initial Item Pool (Study 2)

There were three main purposes of the expert review, which relate to maximizing content validity:

1) To obtain the experts' ratings of how relevant they think each item was to the construct the scale is meant to measure;

2) To obtain the experts' evaluation of each item's clarity and conciseness; and

3) To allow the experts to provide feedback on how the item pool thus far may *fail* to reflect the phenomenon under measurement.

The experts were provided not only the item pool but also the working definition of the construct. The advice then rendered by the experts was taken under consideration; however, per DeVellis (2012), content experts may not be knowledgeable about scale development, and it is ultimately the researcher's responsibility to accept or reject their advice.

4.1.1 Methods

A list of specific people and types of people knowledgeable about wearable technology and/or the factors affecting the social acceptability of a worn object was developed as a recruitment guide. This list was derived from personal contacts of the author and her major professor, as well as literature searches and Google searches. Potential participants were emailed an invitation to the study, which explained that there were three main purposes in having knowledgeable people review the initial pool of items of the WEAR Scale: 1) to obtain their ratings of how relevant they think each item is to the construct the scale is meant to measure; 2) to obtain their evaluations of each item's clarity and conciseness; and 3) to allow them to provide feedback on how the item pool thus far may fail to reflect the construct (social acceptability of a wearable) under measurement. Potential participants were advised that it should take them less than one minute to review each of the 73 items, their participation would take about 60 to 90 minutes, and the survey would take place entirely online via Qualtrics. Participants were offered a $20 Amazon.com gift card as a small token of appreciation for their participation.

Once potential participants stated they wished to participate, they were emailed a link to the informed consent approved by the Institutional Review Board protocol 15-498 (Appendix D). Following their consent, they were provided a link to the study survey. First, the participant chose how to be described in publications: 1) to be described in an anonymous and broad manner, e.g., "an employee with 10 years experience at a large technology company" or "a journalist with 5 years experience testing new wearable devices"; or 2) to have their identity published, e.g., "Jill Smith, technology writer for Yahoo Tech." Second, they were provided instructions, an example of what the finished WEAR Scale would look like, and the working definition of the construct *social acceptability of a wearable device*. The survey then consisted of the 73 items listed in section 3.2.2, each followed by three choices (very relevant to social acceptability of a wearable, somewhat relevant to social acceptability of a wearable, and not relevant to social acceptability of a wearable) as well as a comments box.

The three experts (one male, two female) who participated chose to have their identities published as follows: Dr. Joseph J. LaViola Jr., Associate Professor at the University of Central Florida; Jamie Sherman, Ph.D., Anthropologist and Research Scientist, Intel Corporation; and Deepa Sood, CEO of Cuff.

4.1.2 Results (revised item pool v.2) and Discussion

The three experts rated each of the 73 items as: very relevant to social acceptability of a wearable (scored as 1); somewhat relevant to social acceptability of a wearable (scored as 2); or not relevant to social acceptability of a wearable (scored as 3). Table 19 provides the mean score for each category of questions (as previously coded) as well as the mean for each question. A lower score, then, represents the better items (rated as more relevant to the construct).

Table 19.
Category Means (across questions) and Question Means (across expert ratings)

Category/Question	Mean Score (lower is better)
Category: Aesthetics	***1.60***
1. This device is aesthetically pleasing.	1.00
2. This device seems like "the latest version."	2.33
3. This device is stylish.	1.33

Table 19. continued

Category/Question	Mean Score (lower is better)
4. This device is goofy. (R)	1.00
5. This device can be either casual or formal.	2.00
6. This device is fashionable.	1.33
7. This device is sleek, not clunky.	1.33
8. This device could trend.	2.33
9. This device is too obvious. (R)	2.33
10. This device might be considered disfiguring to its wearer. (R)	1.00
11. This device seems to offer options for personalization, so that everyone is not wearing the “same thing.”	1.67
Category: Available/Ordinary	***2.17***
12. This device seems to be accessible, that is, affordable and not in limited release.	2.33
13. People who do not own this device may not feel good around a person wearing it. (R)	2.33
14. There has been a lot of media buzz about this device. (R)	2.00
15. This device is very new. (R)	2.33
16. Wearing this device would be a show of status or tech-savvy. (R)	2.00
17. This device is similar to existing acceptable devices or accessories.	2.00
Category: Consequences	***1.96***
18. This device could help people.	1.67
19. This device could allow its wearer to take advantage of people. (R)	2.00
20. This device could make people uncomfortable. (R)	1.67
21. The wearer of this device could be considered rude or not acting within social constraints. (R)	1.67
22. This device would “cost” society. (R)	2.33
23. This device would have a positive effect on the social world.	2.33
24. This device would be distracting when driving. (R)	2.00
25. Use of this device raises privacy issues. (R)	1.67
26. Use of this device could be socially stigmatizing. (R)	1.33

Table 19. continued

Category/Question	Mean Score (lower is better)
27. This device seems like it would be annoying or add confusion to the typical interactions of people. (R)	2.00
28. This device's placement on the body could cause awkwardness or embarrassment. (R)	1.33
29. This device does not seem to solve any problems, but does pose potential risks. (R)	2.67
30. Use of this device would create more joy than anxiety.	2.33
31. Use of this device would be more threatening than exciting. (R)	2.00
32. It seems this device could make people smarter.	2.33
Category: Ergonomics	***1.33***
33. This device seems comfortable, not bulky.	1.33
34. This device might restrict movement or physically get in the way. (R)	1.67
35. The size of this device is conveniently small.	1.33
36. This device could cause health concerns. (R)	1.00
37. This device has a natural fit with the body and how people look.	1.33
Category: Functionality	***2.17***
38. This device has too many functions. (R)	2.33
39. This device seems to be useful and easy to use.	2.00
Category: Judgment	***1.72***
40. This device puts the wearer above others in terms of status. (R)	2.00
41. This device symbolizes something undesirable. (R)	2.00
42. This device seems creepy. (R)	1.00
43. This device is cool.	1.33
44. This device seems like "too much" technology. (R)	1.67
45. My initial knowledge of this device has made a positive impression.	2.33
Category: Norms	***1.61***
46. This device seems fairly common.	2.00
47. This device could be considered a normal part of life.	1.00

Table 19. continued

Category/Question	Mean Score (lower is better)
48. A wearer of this device would be keeping to the social norms we need to stick to.	1.67
49. I can imagine that people would be interested in this device and would not have a problem wearing it.	1.67
50. This device is like the clothing and accessories typically worn in our society.	1.33
51. Wearing this device could be considered inappropriate. (R)	2.00
Category: Others' reactions	***1.94***
52. Wearing this device would elicit no reaction or a neutral reaction from other people.	2.00
53. There is no chance of being ridiculed when wearing this device.	2.00
54. The wearer of this device would not be singled out in a crowd.	2.33
55. This device would be generally accepted by the vast majority of people.	1.33
56. The wearer of this device would get a positive reaction from others.	1.67
57. Wearing this device would open possibilities with other people (instead of closing off possibilities with other people).	2.33
Category: Others' thoughts	***1.33***
58. The majority of people probably think this device is OK to wear in public.	1.33
59. The wearer of this device would not be judged negatively by others.	1.33
60. People would not be offended by the wearing of this device.	1.33
61. I think my peers would find this device acceptable to wear.	1.33
Category: Qualities of the device or the wearer	***2.28***
62. This device could result in its wearer not paying attention to other people. (R)	2.33
63. The functions of this device do not seem to be invasive.	2.33
64. This device is not weird.	1.33
65. This device has unknown capabilities.	3.00
66. A person wearing this device is probably trustworthy and/or knowledgeable about technology.	2.33
67. This device seems to be an improvement over what has come before.	2.33

Table 19. continued

Category/Question	Mean Score (lower is better)
Category: Self-identity	***1.78***
68. If I saw someone wearing this device, I would think, that person is like me.	2.33
69. I like what this device communicates about its wearer.	1.67
70. This device is consistent with my self-image.	1.67
71. This device would enhance the wearer's image.	1.33
72. The way this device displays membership to a certain social group is unappealing. (R)	2.00
73. I could imagine aspiring to be like the wearer of such a device.	1.67

Table 20 shows how the categories ranked in terms of relevancy to social acceptability of a wearable.

Table 20.

Categories Ranked Most Relevant to Least Relevant to Construct

Category	Mean Score (lower is more relevant)
Ergonomics	1.33
Others' thoughts	1.33
Aesthetics	1.60
Norms	1.61
Judgment	1.72
Self-identity	1.78
Others' reactions	1.94
Consequences	1.96
Available/Ordinary	2.17
Functionality	2.17
Qualities of the device or the wearer	2.28

In considering individual items to remove from the pool, one item had a mean score of 3.00, one item had a mean score of 2.67, and 19 items had a mean score of 2.33 (Table 21).

Table 21.

Poorest scoring items

Mean score	Question
3.00	65. This device has unknown capabilities.
2.67	29. This device does not seem to solve any problems, but does pose potential risks. (R)
2.33	2. This device seems like “the latest version.” 8. This device could trend. 9. This device is too obvious. (R) 12. This device seems to be accessible, that is, affordable and not in limited release. 13. People who do not own this device may not feel good around a person wearing it. (R) 15. This device is very new. (R) 22. This device would “cost” society. (R) 23. This device would have a positive effect on the social world. 30. Use of this device would create more joy than anxiety. 32. It seems this device could make people smarter. 38. This device has too many functions. (R) 45. My initial knowledge of this device has made a positive impression. 54. The wearer of this device would not be singled out in a crowd. 57. Wearing this device would open possibilities with other people (instead of closing off possibilities with other people). 62. This device could result in its wearer not paying attention to other people. (R) 63. The functions of this device do not seem to be invasive. 66. A person wearing this device is probably trustworthy and/or knowledgeable about technology. 67. This device seems to be an improvement over what has come before. 68. If I saw someone wearing this device, I would think, that person is like me.

Fifteen items received comments from one expert as provided below. Four were among the poorest scoring items and are noted as *Poor item*.

5. This device can be either casual or formal.

While not nuanced, social acceptability is context specific. acceptable in some circumstances but not others (e.g., wearing a bathing suit to the office). So if the goal is not just "is it acceptable" but also "where and when is it acceptable" then this is a useful question. If the goal is a "yes it is/no it's not acceptable" then this question is not useful.

15. This device is very new. (Reverse scored) *Poor item*
    Not clear what scoring should be. In some contexts/cultures "new" is a positive value, in others it might be negative.

16. Wearing this device would be a show of status or tech-savvy. (Reverse scored)
    Again, very unclear how to score this unless you know whether for that culture/context status and tech savvy are valued positively or negatively and where/when.

24. This device would be distracting when driving. (Reverse scored)
    Relevant only if you are interested in where and when things are socially acceptable rather than if they are so at all.

25. Use of this device raises privacy issues. (Reverse scored)
    Not directly, but like others, speaks to overall concerns about a device.

33. This device seems comfortable, not bulky.
    This is more personal that social.

34. This device might restrict movement or physically get in the way.
    Same as above.

36. This device could cause health concerns. (Reverse scored)
    If "for yourself" probably isn't a "social" issue, but if there is concern that it could cause health concerns for others, then that would be a social acceptability issue.

39. This device seems to be useful and easy to use.
    Not about the social.

40. This device puts the wearer above others in terms of status. (Reverse scored)
    Problematic - this seems to assume status is bad. In many cultures, this would be a positive value. Social acceptability is about how I look to others and how they look to me and how "appropriate" to the moment or place or world it is perceived to be.

45. My initial knowledge of this device has made a positive impression. *Poor item*
    Pretty vague.

51. Wearing this device could be considered inappropriate. (Reverse scored)
    Could use better wording - bathing suits are inappropriate at the office but they are socially acceptable - so long as you are at the beach.

57. Wearing this device would open possibilities with other people (instead of closing off possibilities with other people). *Poor item*
    Opaque.

66. A person wearing this device is probably trustworthy and/or knowledgeable about technology. *Poor item*

> Being trustworthy and knowledgeable doesn't make one socially acceptable - Steve Mann is over the top but likely both...

72. The way this device displays membership to a certain social group is unappealing. (Reverse scored)

> This should be paired with "the way this device displays membership to a certain social group is appealing" - otherwise it doesn't tell you much.

Finally, the following comments were made at the conclusion of the questionnaire:

1. Acceptability is not only culture specific but context specific. Wearing pajamas to work is not socially acceptable.

2. Lots of assumptions embedded in questions regarding positive and negative values - some communities place a high value on demonstrating status, others see standing out as a bad thing. To be effective, questions will need to tease out whether participants see these aspects as pos or neg.

3. Focus on aesthetics, how I appear to others, how others appear to me.

4. While positive reactions in general likely correlate to acceptability, they do not necessarily do so. I would stay away from questions about what the device does.

These comments are taken as the commentators' expert opinions, and are to be considered as a part of the grounded data along with the literature and interview responses. Comment 2 refers to assumptions that may appear in some items about positive and negative values like status, which were derived from the interviews and may very well be a result of a rather homogenous and small interview sample. In particular, the comments on the individual items indicate that items 16 and 40 may be problematic.

Additionally, the comments suggest focusing on aesthetics, which is also a focus of the media on this topic (e.g., Wasik, 2014); however, the larger picture garnered throughout this research suggests that aesthetics as a factor is perhaps over-emphasized. Similarly, although these comments advise staying away from items about functions, other data suggested that "over-functionality" and/or unclear functions (*is that device recording me?*)

do have a negative impact on social acceptability.

In considering which items to delete to arrive at WEAR Scale v.2, removing the one item that received a mean score of 3.00, the one item that received a mean score of 2.67, and the 19 items that received a mean score of 2.33 (see Table 21, *Poorest scoring items)* would pare down the item pool to 52 items. Given the comments, three additional items (5, 16, and 40) were removed. Finally, the author agrees with the comment that an additional item (*The way this device displays membership to a certain social group is appealing*) would make sense as a counter to item 72 (*The way this device displays membership to a certain social group is unappealing*). Therefore, the WEAR Scale following expert review consists of 50 items, as displayed in Table 22.

Table 22.

WEAR Scale v.2 (Result of Expert Review)

Category (new item number)
Category: Aesthetics
1. This device is aesthetically pleasing. (1)
3. This device is stylish. (2)
4. This device is goofy. (R) (3)
6. This device is fashionable. (4)
7. This device is sleek, not clunky. (5)
10. This device might be considered disfiguring to its wearer. (R) (6)
11. This device seems to offer options for personalization, so that everyone is not wearing the "same thing." (7)
Category: Available/Ordinary
14. There has been a lot of media buzz about this device. (R) (8)
17. This device is similar to existing acceptable devices or accessories. (9)
Category: Consequences

Table 22. continued

Category (new item number)

18. This device could help people. (10)

19. This device could allow its wearer to take advantage of people. (R) (11)

20. This device could make people uncomfortable. (R) (12)

21. The wearer of this device could be considered rude or not acting within social constraints. (R) (13)

24. This device would be distracting when driving. (R) (14)

25. Use of this device raises privacy issues. (R) (15)

26. Use of this device could be socially stigmatizing. (R) (16)

27. This device seems like it would be annoying or add confusion to the typical interactions of people. (R) (17)

28. This device's placement on the body could cause awkwardness or embarrassment. (R) (18)

31. Use of this device would be more threatening than exciting. (R) (19)

Category: Ergonomics

33. This device seems comfortable, not bulky. (20)

34. This device might restrict movement or physically get in the way. (R) (21)

35. The size of this device is conveniently small. (22)

36. This device could cause health concerns. (R) (23)

37. This device has a natural fit with the body and how people look. (24)

Category: Functionality

39. This device seems to be useful and easy to use. (25)

Category: Judgment

41. This device symbolizes something undesirable. (R) (26)

42. This device seems creepy. (R) (27)

43. This device is cool. (28)

44. This device seems like "too much" technology. (R) (29)

Category: Norms

46. This device seems fairly common. (30)

47. This device could be considered a normal part of life. (31)

48. A wearer of this device would be keeping to the social norms we need to stick to. (32)

Table 22. continued

Category (new item number)
49. I can imagine that people would be interested in this device and would not have a problem wearing it. (33)
50. This device is like the clothing and accessories typically worn in our society. (34)
51. Wearing this device could be considered inappropriate. (R) (35)
Category: Others' reactions
52. Wearing this device would elicit no reaction or a neutral reaction from other people. (36)
53. There is no chance of being ridiculed when wearing this device. (37)
55. This device would be generally accepted by the vast majority of people. (38)
56. The wearer of this device would get a positive reaction from others. (39)
Category: Others' thoughts
58. The majority of people probably think this device is OK to wear in public. (40)
59. The wearer of this device would not be judged negatively by others. (41)
60. People would not be offended by the wearing of this device. (42)
61. I think my peers would find this device acceptable to wear. (43)
Category: Qualities of the device or the wearer
64. This device is not weird. (44)
Category: Self-identity
69. I like what this device communicates about its wearer. (45)
70. This device is consistent with my self-image. (46)
71. This device would enhance the wearer's image. (47)
72. The way this device displays membership to a certain social group is unappealing. (R) (48)
73. I could imagine aspiring to be like the wearer of such a device. (49)
74. (New) The way this device displays membership to a certain social group is appealing. (50)

The outcome of Study 2, WEAR Scale v.2, supports the content validity of the WEAR Scale v.2 because its items were derived directly from the literature and interview data, and because the items received a mean rating of 1.56 from the experts (a "1" representing “very relevant to social acceptability of a wearable” and a “2” representing “somewhat relevant to social acceptability of a wearable”). Before moving on to Study 3, which was the administration of the WEAR Scale v.2 to a sample population, the items and scales that were used to test construct validation in Study 3 are discussed.

4.2 Determine Items or Scales for Validation Purposes

At this point in the scale development process, the researcher may determine which items or scales to use for purpose of testing construct validity (DeVellis, 2012). Some researchers do not assess construct validity until after the first assessment, by conducting an additional study. But DeVellis suggested presenting validation items when administering the items to a sample of respondents, for reasons of convenience, which has been implemented by other researchers (e.g., Yildirim & Correia, 2015) and was implemented in the present research.

As discussed in 2.2.3, the construct validity of the WEAR Scale may be evidenced by demonstrating its correlation with related measures. The resulting patterns of relationships either provide support for validity or provide clues for revisions if the relationships are not as expected (DeVellis, 2012). Related constructs are tested as a method for instrument refinement, which are procedures whose objective is to improve an instrument’s representation of a construct (Smith & McCarthy, 1995).

When possible, theory is used to choose items or scales to validate a new measure (DeVellis, 2012). That is, if existing theory asserts that construct X (for which a valid and reliable measure exists) is either positively or negatively correlated to the measure under development, then confirming that relationship provides evidence that the new measure possesses construct validity. However, because there is a lack of theory pertaining to wearables and their social acceptability (and in fact an objective of this research is to develop the WEAR Scale in support of theory-building), the task of selecting existing measurable constructs or individual items for validation purposes was based on a review of related literature. As explained in more detail below, then, participants in Study 3 responded to the Affinity for Technology Scale, self-reported their level of optimism and their age, and rated the likeableness of a person in a wearing a certain wearable device.

4.2.1 Affinity for Technology Scale, optimism, and age

Edison and Geissler (2003) developed the Affinity for Technology Scale, a robust and usable measure to assess attitudes towards general technology (Appendix E*, Affinity for Technology Scale*). Given that wearables are a form of technology, a positive relationship between the Affinity for Technology score and WEAR score was taken as evidence for validity of the WEAR Scale.

Edison and Geissler (2003) also examined factors that contribute to the acceptance or resistance of new technologies, finding that individuals who have a positive attitude towards new technologies tend to be younger and more optimistic. Therefore, participants will be asked their age and their self-assessed level of optimism. A positive relationship between optimism and WEAR score, and a negative relationship between age and WEAR score, will be taken as evidence for validity.

In addition to these measures assessing construct validity, they also serve as a test of known-group validity, which pertains to the WEAR Scale's ability to differentiate among groups of people who *should* score relatively high or low (Netemeyer, Bearden, & Sharma, 2003). That is, younger people, optimistic people, and people with an affinity for technology should score higher on the WEAR Scale.

4.2.2 Likeableness Ratings

While affinity for technology is one path to validation, it does not capture the social dimension of acceptability. Dress and appearance are a form of nonverbal communication about the wearer, and particular clothes or items convey messages that are shared by observers (e.g., L.L. Davis, 1984; Gibbins & Schneider, 1980). Studies have demonstrated that judgments of personality traits and social status are made based on an individual's clothing (Douty, 1963) and that clothing and judgments of sociability are related (Davis & Lennon, 1988).

Therefore, another item that was tested was the perceived likeableness of a person wearing a given device, as a proxy for social acceptability. Participants were shown a photo and description of the wearable selected for testing and asked to imagine seeing someone in a coffee shop using the device. They were be asked their impression of this person by choosing three words out 20. Ten of the words were rated very high on likeableness, and ten of the words were rated very low on likeableness, in a previous study of ratings of 555 personality-trait words (Anderson, 1968). The high likeableness words were scored +1 each: sincere, trustworthy, honest, intelligent, considerate, understanding, dependable, loyal, thoughtful, and truthful. The low likeableness words were scored -1 each: phony, mean, liar, untrustworthy, unkind, malicious, untruthful, obnoxious, dishonest, and cruel. Given that wearing a device is a social act and acceptance and likeableness are closely-related constructs, a positive relationship between the likeableness score and wearable acceptability score was expected and taken as evidence for validity.

Having created a pool of items vetted by experts, and chosen related measures for validity testing, these items could be administered to a sample of respondents. Chapters 5 and 6 address the metholdology and results of three administrations of the 50-item WEAR Scale and validity measures.

CHAPTER 5

STUDY 3 AND RELATED DEVELOPMENT

5.1 Administer Items (Bluetooth Headset Stimulus)

Study 2, expert review, resulted in 50 items (WEAR Scale v.2) to administer to a sample of respondents. This chapter describes how these items were subjected to pilot testing and revision, followed by administration of WEAR v.2.1 to the target population and item evaluation. The resulting data were also examined to assess their predicted relation to the scales and items identified in Section 4.2 (Determine Items or Scales for Validation Purposes), to evaluate the Scale's construct validity.

5.1.1 Methods

As previously mentioned, a pilot test should be conducted prior to administration to the target population. Therefore, two members of the target population were asked to complete the survey as if they were taking it as a participant. The pilot reviewers were asked to make a note of any items that they thought: were not clear, were confusing because they contained multiple ideas, were overly long or wordy, or contained hard to understand words (DeVellis, 2012). The resulting WEAR Scale v.2.1 (Appendix F) contains: the items following the expert study and, if recommended in the pilot review, the item as revised. The items were randomly ordered for use in Study 3. Appendix F shows each item's number following expert review, the item's number in Study 2 prior to expert review, and the item's category.

The five items that were revised according to the pilot reviewers' feedback are as follows:

ORIGINAL: This device has a natural fit with the body and how people look.
REVISED: This device looks natural and not out of place on the body.

ORIGINAL: The wearer of this device could be considered rude or not acting within social constraints. (R).
REVISED: The wearer of this device could be considered rude. (R).

ORIGINAL: Use of this device could be socially stigmatizing. (R)
REVISED: Use of this device could hurt the wearer's social reputation. (R)

ORIGINAL: Wearing this device would elicit no reaction or a neutral reaction from other people.
REVISED: Wearing this device would cause no reaction, or a neutral reaction, from other people.

ORIGINAL: The way this device displays membership to a certain social group is unappealing. (R)
REVISED: I don't like how this device shows membership to a certain social group. (R)

In administering the item pool to a sample of respondents, it is generally agreed that 300 participants are sufficient (Clark & Watson, 1995; DeVellis, 2012, Nunally & Bernstein, 1994). Other researchers have suggested that 100 to 200 participants are needed (Spector, 1992). Based on these heuristics, a sample of 300 participants was sought to respond to the initial item pool v.2.1 and the items/scales for validation.

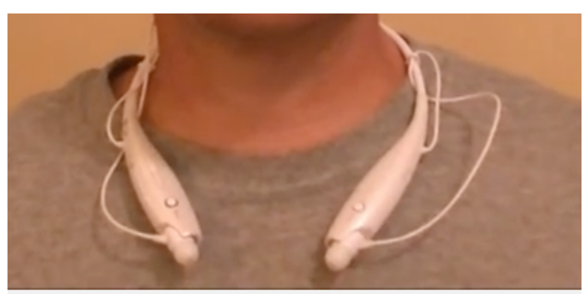
Per methods approved by the Institutional Review Board protocol 15-647 (Appendix G), the invitation email was sent to all Iowa State University students (approximately 36,000), and to departments. Also, personal contacts of the researcher were invited via email or verbally, using the email as talking points. Participants were required to be age 18 to 30 because this is the population for which the scale is being developed, as was explained in the Study 1 methodology. In the recruitment email, it was explained that at the end of the study, participants could enter their name/email into a random drawing for a $90 Amazon.com gift certificate. Potential participants who wished to participate clicked on a link in the recruitment email that then took them to the informed consent (approved by the Institutional Review Board under IRB 15-647, Appendix G), after which they responded to the study questions in a Qualtrics web-based survey.

In administering the items to the development sample, a wearable was presented so that the participants could respond to the scale questions in relation to a particular device. The wearable that was chosen was the LG Tone+ HBS-730 Wireless Bluetooth Stereo Headset Neckband (Table 23), because it was an existing product that participants might own themselves, or may have seen on other people, but it was not widely worn and did not resemble an existing accepted accessory like a wristwatch. Therefore, it was expected to evoke useful variability among participants.

Table 23.
Wearable Stimulus and Description for Study 3

This is a Bluetooth headset that is worn around the neck. The earbuds are held in the ends with magnets when the user does not have them in his or her ears. It interacts with one's mobile phone so that the user can listen to music, and adjust volume or songs via the headset. The user can also talk on the phone through this device (using its earbuds and built-in microphone), as well as use voice commands to check the weather, for example.

http://vapingunderground.com/threads/lg-tone-hbs-730-wireless-bluetooth-stereo-headset-neckband-style-hbs730.73983/



https://www.youtube.com/watch?v=ucFnZS8sOww

Most studies pertaining to clothing and human behavior are concerned with evaluations of people wearing certain clothing, according to Davis and Lennon (1988). Presentation of stimuli has been accomplished in various ways, including via photos, drawings, live models, and written descriptions. One issue to be cautious of is that characteristics of the person, rather than what is being worn, can affect the outcome of the study. A written description is a way to "present" a stimulus person, and can control for characteristics (i.e., omitting characteristics like gender and race from a description of a person, which would otherwise be variable) (Davis & Lennon, 1988). Written descriptions and photos of wearables (without users or with minimal user identification) were used in WEAR Scale development as much as possible to avoid confounding perceptions of a wearable with perceptions of age, race, gender, etc. For the likeableness validation item, participants were asked to imagine a situation, rather than being provided a photo of the device on an actual person, because using real models would confound judgments of the device with judgments of other characteristics of the model. Written descriptions of "stimulus persons" has been used in other research to avoid this problem (e.g., Belk, 1978, Belk, 1980, and Mathes & Kempher, 1976, as described in Davis & Lennon, 1988).

5.1.2 Results

The informed consent process was capped at 320 participants, and 302 participants submitted the survey. The time taken to submit the survey ranged from 3 to 116 minutes, with a mean of 9.37 minutes and a standard deviation of 8.69 minutes. The author omitted data from participants who spent less than six minutes on the survey, thus excluding 65 participants. Data from 16 other participants were omitted – two whose ages were not in the

18-to-30 range, and 14 who skipped one or more WEAR items. Missing values in the validation items were excluded pairwise from those analyses.

Thus, data from 221 participants were used. While the goal was 300 participants, as recommended by some researchers (Clark & Watson, 1995; DeVellis, 2012, Nunally & Bernstein, 1994), other researchers have suggested that 100 to 200 participants are sufficient (e.g., Spector, 1992). Study 3 was repeated with different wearables and with a larger participant pool in Study 4, and results are compared in Chapter 6.

All 221 participants used in the data analysis were aged 18 to 30. The mean age was 21.1 (*N*=220; SD=2.67). Further demographics are reported in Table 24.

Table 24.

Demographics of 221 participants

		N	%
Gender	Male	127	57.5
	Female	93	42.1
	Unanswered	1	0.4
Ethnicity	Hispanic or Latino	16	7.3
	Not Hispanic or Latino	204	92.3
	Unanswered	1	0.4
Race	American Indian or Alaska Native	4	1.8
	Asian	24	10.8
	Black or African American	7	3.2
	Native Hawaiian or other Pacific Islander	1	0.5
	White	182	82.4
	Unanwered	3	1.3
Education	High school graduate	17	7.7
	Some college	150	67.9
	College graduate	18	8.1
	Some graduate work	21	9.5
	Masters, Ph.D., or other advanced degree	15	6.8

Table 25 presents the summary item statistics after reverse coding. As a reminder, each item was rated on a Likert scale from 1 to 6. Cronbach's alpha for WEAR v.2.1 was 0.96, which demonstrates high internal consistency.

Table 25.

Summary Item Statistics for WEAR v.2.1

	Mean	Minimum	Maximum	Range	Variance
Item Means	3.57	2.43	4.84	2.41	0.40
Item Variances	1.45	0.76	1.97	1.21	0.08

5.2 Evaluate the Items

In evaluating the items, an initial assessment was first conducted to identify and remove any obviously problematic items and assess whether these data are appropriate for factor analysis. If yes, factor analysis was conducted and the items were submitted to extraction and rotation, after which the coefficient alpha is examined. The resulting scale is then used to test the validity hypotheses.

5.2.1 Initial assessment

Following administration, the next step was to assess the performance of the initial pool of items (v.2.1). As discussed in Chapter 2, the most important quality of an item is a high correlation with the true score of the latent variable (DeVellis, 2012). Because it is not possible to directly measure this true score, inferences based on formal measurement models stipulate that a set of scale items should be highly correlated.

5.2.1.1 Methods and Results

In assessing the performance of the pool of items (v.2.1), first the correlation matrix was used to examine correlations between items (DeVellis, 2012). DeVellis (2012) advised examining the corrected item-total correlation for each item, which correlates the item being evaluated with all the scale items, excluding itself. This excludes the correlation of the item with itself and helps avoid an inflated correlation coefficient. Tabachnick and Fidell (2007) suggested that coefficients should generally exceed 0.3 to proceed with factor analysis.

Second, item variance was examined; in general, a relatively high variance is desirable (DeVellis, 2012). A lack of variance means that the item does not discriminate among individuals. Third, item means were examined, and in general a mean close to the center of possible scores is advantageous (DeVellis, 2012).

Corrected item-total correlations are shown in Table 26. Because the objective of this item analysis was to remove items that do not contribute to an internally consistent scale (Spector, 1992), the one item with a negative correlation was removed, item 19. This item, *there has been a lot of media buzz about this device,* was derived from the interviews. While some interviewees felt that media buzz was disdainful and contributed to lack of social acceptability, there is also clearly an opposite trend in the literature. Due to these inconsistencies, this item was removed from further analysis.

Table 26.

Corrected Item-Total Correlations

Item	Item-Total Correlations
1. I think my peers would find this device acceptable to wear.	0.76
2. The size of this device is conveniently small.	0.61
3. This device is like the clothing and accessories typically worn in our society.	0.66
4. This device looks natural and not out of place on the body.	0.66
5. This device could make people uncomfortable. (R)	0.58
6. This device is consistent with my self-image.	0.67
7. This device seems to be useful and easy to use.	0.61
8. The way this device displays membership to a certain social group is appealing.	0.44
9. I like what this device communicates about its wearer.	0.69

Table 26. continued

Item	Item-Total Correlations
10. A wearer of this device would be keeping to the social norms we need to stick to.	0.63
11. This device might be considered disfiguring to its wearer. (R)	0.44
12. This device seems creepy. (R)	0.69
13. This device seems like “too much” technology. (R)	0.61
14. This device might restrict movement or physically get in the way. (R)	0.48
15. This device is fashionable.	0.70
16. This device seems comfortable, not bulky.	0.63
17. The wearer of this device could be considered rude. (R).	0.34
18. This device symbolizes something undesirable. (R)	0.68
19. There has been a lot of media buzz about this device. (R)	-0.37
20. This device is cool.	0.66
21. This device could allow its wearer to take advantage of people. (R)	0.07
22. I can imagine that people would be interested in this device and would not have a problem wearing it.	0.67
23. This device is sleek, not clunky.	0.67
24. This device seems to offer options for personalization, so that everyone is not wearing the “same thing.”	0.47
25. This device could help people.	0.34
26. This device would be generally accepted by the vast majority of people.	0.75
27. This device is not weird.	0.83
28. The wearer of this device would not be judged negatively by others.	0.68
29. This device is similar to existing acceptable devices or accessories.	0.57
30. Wearing this device could be considered inappropriate. (R)	0.42
31. This device could be considered a normal part of life.	0.67
32. Use of this device could hurt the wearer’s social reputation. (R)	0.66
33. This device would be distracting when driving. (R)	0.08
34. This device seems fairly common.	0.62
35. This device could cause health concerns. (R)	0.12

Table 26. continued

Item	Item-Total Correlations
36. Use of this device raises privacy issues. (R)	0.20
37. I could imagine aspiring to be like the wearer of such a device.	0.67
38. There is no chance of being ridiculed when wearing this device.	0.56
39. Use of this device would be more threatening than exciting. (R)	0.50
40. This device is stylish.	0.76
41. This device's placement on the body could cause awkwardness or embarrassment. (R)	0.60
42. Wearing this device would cause no reaction, or a neutral reaction, from other people.	0.58
43. I don't like how this device shows membership to a certain social group. (R)	0.32
44. This device is goofy. (R)	0.78
45. This device would enhance the wearer's image.	0.48
46. The wearer of this device would get a positive reaction from others.	0.59
47. This device is aesthetically pleasing.	0.68
48. People would not be offended by the wearing of this device.	0.46
49. This device seems like it would be annoying or add confusion to the typical interactions of people. (R)	0.60
50. The majority of people probably think this device is OK to wear in public.	0.64

Item means ranged from 2.43 to 4.84, with a mean of 3.56. As desired, the mean of the item means was very close to the center of the scale (3.50). Item variances ranged from 0.76 to 1.97, with a mean of 1.40, which demonstrates reasonable variability. Factor analysis then proceeded with 49 items.

5.2.2 Factor analysis

Factor analysis is used to determine which group of items (if any) constitute a unidimensional set. Spector (1992) stated that exploratory factor analysis can help determine if there are separate components for a group of items, and it was used here (rather than confirmatory factor analysis) because there was no hypothesized structure. Factors can 1) indicate that there are separate constructs or 2) represent aspects of the single originally-conceived construct. The outcome of exploratory factor analysis results in two issues that can only be answered using researcher judgment: the number of and interpretation of the factors. One strategy is to rotate several different numbers of factors and then let meaningfulness guide the decision. It is also the decision of the researcher to decide whether these factors are subdimensions of a unidimensional scale or whether the scale is measuring multiple constructs (Spector, 1992).

According to Spector (1992), the decision to divide a construct should be based on both theoretical and empirical utility. Subdividing a construct should add explanatory power. If dimensions do not add to utility or predictive power, then parsimony should be followed.

5.2.2.1 Methods and Results

Extraction.

The technique of principal components analysis (PCA) was used to examine whether the remaining 49 items measured a single construct of “social acceptability of wearable,” or whether multiple constructs underlay the set of items. SPSS Version 23 was used to conduct PCA using extraction and rotation instructions provided by Pallant (2007). Furthermore, Pallant (2007) recommended measures that can be generated in SPSS to assess the factorability of the data: Bartlett's test of sphericity, which should be significant at $p < .05$, and the Kaiser-Meyer-Olkin measure of sampling adequacy, which should be 0.6 or above. For these 49 items, Bartlett's test of sphericity was significant at $p <.001$, and the Kaiser-Meyer-Olkin measure of sampling adequacy value was 0.94. These 49 items are therefore clearly factorable.

Factor extraction was then used to determine the fewest number of factors that can represent the relationships among the variables (Pallant, 2007). The most common technique, and the one used here, is that of PCA. This exploratory approach allows the researcher to explain as much of the variance in the data as possible while also finding the simplest solution, i.e., the one with the fewest factors. Three techniques that are helpful in providing information to decide the number of factors are Kaiser's criterion (Kaiser, 1960), Scree test (Catell, 1966), and parallel analysis (Horn, 1965) (see also Pallant, 2007). Each is considered in turn below.

Kaiser's criterion (Kaiser, 1960) is one of the most commonly used techniques, and is also known as the eigenvalue rule. Simply put, a factor is retained if its eigenvalue is greater than 1.0. The eigenvalue represents the amount of total variance described by that factor (Pallant, 2007). The Total Variance Explained (Table 27) provides the Initial Eigenvalues for the components with Eigenvalues greater than 1.0. These first nine components recorded eigenvalues above 1.0, and explain a total of 65.56 percent of the variance.

Table 27.

Total Variance Explained.

	Initial Eigenvalues	
Component	Total	Percent of Variance
1	18.47	37.69
2	4.22	8.61
3	1.75	3.56
4	1.60	3.27
5	1.43	2.93
6	1.33	2.70
7	1.23	2.50
8	1.10	2.24
9	1.01	2.06

The scree test (Catell, 1966) provides additional information in that it is a plot of each of the eigenvalues of the factors, which then allows the potential identification of a point in which the curve changes from mostly vertical to mostly horizontal (i.e., the “elbow”). Factors above the elbow are retained, as they contribute most to explaining the variance (Catell, 1966; Pallant, 2007). The elbow of the scree plot indicates a large drop in eigenvalue (and thus information), indicating the number of factors that reasonably make up the scale, which lie to the left of the elbow (DeVellis, 2012). The scree plot (Figure 4.), suggests a two-factor solution. This is in contrast to the nine-factor solution offered by Kaiser’s criterion, which has been criticized for the retaining too many factors in some circumstances (Pallant, 2007).

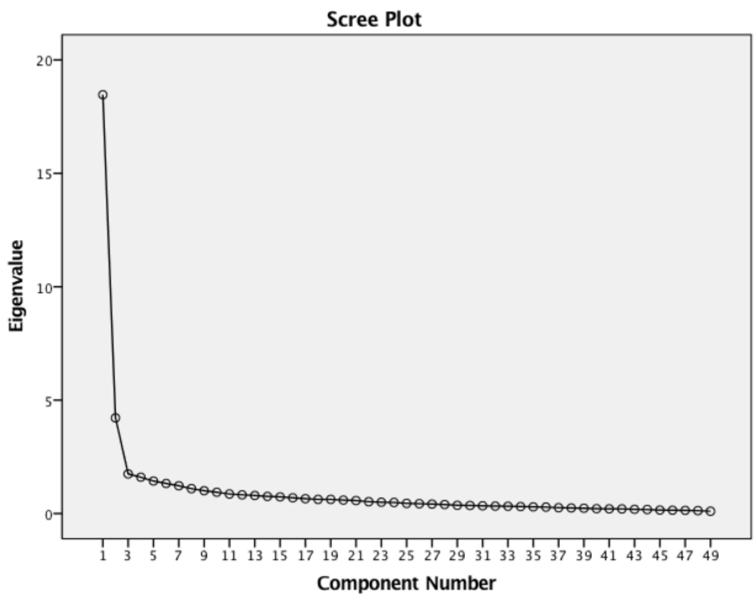


Figure 4. Scree Plot – Bluetooth Headset

Parallel analysis (Horn, 1965) involves comparing the data set's eigenvalues to the eigenvalues of a randomly generated data set of the same size. The eigenvalues that are retained, then, are only those that exceed the corresponding values from the random data set. This method has been shown to be more rigorous and thus more accurate than the previously-mentioned two techniques (Pallant, 2007). The procedure involves using the eigenvalues provided in the Total Variance Explained table in conjunction with a simulated data set obtained from Monte Carlo PCA for Parallel Analysis statistical program (Watkins, 2016). The first eigenvalue obtained in SPSS is compared to the first randomly-obtained value from the parallel analysis; if the SPPS value is larger, that factor is retained. Analysis continues with corresponding factors between the SPSS results and parallel analysis results (Pallant, 2007).

The results of parallel analysis, using the maximum number of replications (1000), are shown in Figure 5. Just the first and second eigenvalues obtained in SPSS (18.47 and

4.22) exceed the first two random eigenvalues in parallel analysis (2.06 and 1.94), therefore, parallel analysis suggests retaining Components 1 and 2 for a two-factor solution.

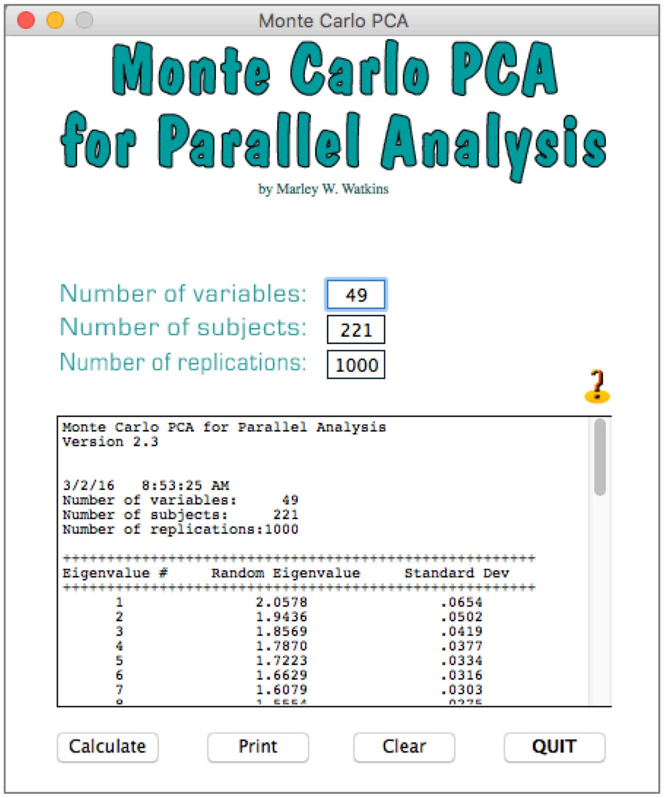


Figure 5. Output from Parallel Analysis.

The Component Matrix provides the unrotated loadings on each of the nine components (Pallant, 2007). All of the items that loaded on Components 3 through 9 also loaded on either Component 1 or 2. The Pattern Matrix reported that rotation failed to converge in 25 iterations for the rotated nine-factor solution. Therefore, the Component Matrix and Pattern Matrix further suggest that a nine-factor solution is not appropriate, and that a lesser-factor solution should be used.

Rotation.

Based on the extraction results above, two factors will be retained because 1) both the scree plot and parallel analysis suggest a two-factor solution, 2) Kaiser's criterion has been criticized for retaining too any factors, 3) the Component Matrix and Pattern Matrix suggest that a nine-factor solution is not appropriate, and 4) parsimony is favored in factor retention. Next considered is factor rotation of a two-factor solution.

While extraction helps the researcher determine the number of factors, rotation helps the researcher with interpreting the nature of those factors, by clustering the factors according to latent variables (DeVellis, 2012; Pallant, 2007). Rotation is generally approached in one of two ways. When the underlying constructs are assumed to be correlated, oblique rotation is used; when the underlying constructs are assumed to be uncorrelated, orthogonal rotation is used (DeVellis, 2012; Pallant, 2006). According to Pallant (2007), the researcher should always start with oblique rotation (Direct Oblimin in SPSS). This procedure provides information about the extent of correlation between the factors, and orthogonal rotation can always be conducted as a later step. Additionally, the two techniques usually offer very similar results (Pallant, 2007).

Therefore, the Direct Oblimin (oblique) procedure was conducted first. The percentage of variance explained by this two-factor solution was 46.30 percent (compared to 65.56 percent explained by the nine-factor solution). Component 1 had an Initial Eigenvalue Total of 18.47, explaining 37.69 percent of the variance, and Component 2 had an Initial Eigenvalue Total of 4.22, explaining 8.61 percent of the variance. The Component Correlation Matrix showed the strength between the two factors as 0.24. A lower correlation (below 0.3 according to Pallant, 2007; below 0.32 according to Tabachnick and Fiddell, 2007) means that orthogonal rotation should be used. Thus, the Varimax (orthogonal) rotation procedure was conducted next.

Results of the orthogonal rotation are shown in Table 28. Thirty-one coefficients loaded significant on one factor, that is, 0.30 or greater on their primary component and less than 0.30 on the other component. These 31 coefficients are bolded in the table. Loadings between -0.10 and 0.10 are considered to be zero loadings and are not shown in the table (Brown, 2009). Coefficients that did not load significantly on a single factor are considered complex variables. Simple structure is desirable for the WEAR Scale, which is achieved by excluding these complex variables (Brown, 2009). The categories were identified by the author in analyzing the interview data (Study 2).

Table 28.

Two Orthogonal Rotations of the 49-item WEAR Scale.

Item - Category*	Component**	
	Component 1	Component 2
15. Fashionable – A	**0.85**	
40. Stylish - A	**0.85**	
47. Aesthetically pleasing - A	**0.80**	
20. Cool - J	**0.78**	
4. Natural on body - E	**0.78**	
23. Sleek not clunky - A	**0.78**	
1. Peers find acceptable - OT	**0.78**	0.23
27. Not weird - Q	0.76	0.40
6. Consistent with self-image - SI	**0.75**	
3. Like typical clothing - N	**0.75**	
2. Conveniently small - E	**0.73**	
37. Aspire to be like wearer - SI	**0.72**	0.13
44. Goofy (R) - A	0.72	0.35
9. Like what it communicates - SI	**0.69**	0.23
16. Comfortable not bulky - E	**0.68**	0.13
26. Generally accepted - OR	0.67	0.41
22. Interested in/no problem - N	**0.65**	0.29
10. Keeping to social norms - N	**0.64**	0.20
46. Positive reaction from others - OR	**0.63**	0.15
45. Enhance wearer's image - SI	**0.63**	
34. Seems fairly common - N	**0.63**	0.23
38. No chance of ridicule - OR	**0.61**	0.13
28. Not judged negatively - OT	0.63	0.37
31. Normal part of life - N	0.58	0.38
8. Like group membership - SI	**0.58**	
7. Useful and easy to use - J	**0.57**	0.27
24. Option for personalization - A	**0.56**	
12. Seems creepy (R) - J	0.53	0.51
50. OK to wear in public - OT	0.51	0.45

Table 28. continued

Item - Category*	Component**	
	Component 1	Component 2
29. Similar to existing - AO	0.51	0.32
42. No/neutral reaction - OR	0.49	0.38
41. Body placement awkward - C	0.48	0.41
14. Might restrict movement (R) - E	0.40	0.30
25. Could help people – C	**0.35**	0.13
11. Might be disfiguring (R) - A	0.34	0.33
36. Raises privacy issues (R) - C	-0.14	**0.65**
39. Threatening not exciting (R) – C	0.23	**0.64**
30. Could be inappropriate (R) - N	0.15	**0.61**
43. Don't like group (R) - SI		**0.60**
49. Annoying/add confusion (R) - C	0.37	0.60
21. Wearer could take advantage of people (R) - C	-0.25	**0.59**
32. Could hurt reputation (R) - C	0.45	0.59
5. Make uncomfortable (R) - C	0.36	0.58
17. Could be rude (R) - C		**0.56**
18. Symbolizes undesirable (R) - J	0.50	0.53
48. People not offended - OT	0.27	**0.51**
13. Seems like too much tech (R) - J	0.43	0.50
35. Could cause health concerns (R) - E	-0.14	**0.46**
33. Would be distracting when driving (R) – C		0.26

R=Reverse scored

*Category key: A=Aesthetics; AO=Available/Ordinary; C=Consequences; E=Ergonomics; J=Judgment; N=Norms; OR=Others' Reactions; OT=Others' Thoughts; SI=Self-Identity; Q=Qualities of the Device or Wearer

**Loadings=>0.10.

Table 29 shows the 23 items that loaded on Component 1 and 8 items that loaded on Component 2. These results suggest that Component 1 generally relates to the aesthetics of the wearable and positive social factors, while Component 2 generally relates to fear-based social factors. Typically, further analysis of the components, and weeding-out of the poorer performing items, would occur at this point. However, because the 50 items were tested in Study 4 with two other wearables to compare results, the present PCA analysis paused here.

Table 29.

31 items loading significantly on each component.

Factors and Items	Loading
Factor 1:	
15. This device is fashionable.	0.85
40. This device is stylish.	0.85
47. This device is aesthetically pleasing.	0.80
20. This device is cool.	0.78
4. This device looks natural and not out of place on the body.	0.78
23. This device is sleek, not clunky.	0.78
1. I think my peers would find this device acceptable to wear.	0.78
6. This device seems to be useful and easy to use.	0.75
3. This device is like the clothing and accessories typically worn in our society.	0.75
2. This device is sleek, not clunky.	0.73
37. I could imagine aspiring to be like the wearer of such a device.	0.72
9. I like what this device communicates about its wearer.	0.69
16. This device seems comfortable, not bulky.	0.68
22. I can imagine that people would be interested in this device and would not have a problem wearing it.	0.65
10. A wearer of this device would be keeping to the social norms we need to stick to.	0.64
46. The wearer of this device would get a positive reaction from others.	0.63
45. This device would enhance the wearer's image.	0.63
34. This device seems fairly common.	0.63
38. There is no chance of being ridiculed when wearing this device.	0.61
8. I like how this device shows membership to a certain social group.	0.58
7. This device seems to be useful and easy to use.	0.57
24. This device seems to offer options for personalization, so that everyone is not wearing the "same thing."	0.56
25. This device could help people.	0.35
Factor 2:	
36. Use of this device raises privacy issues. (R)	0.65
39. Use of this device would be more threatening than exciting. (R)	0.64
30. Wearing this device could be considered inappropriate. (R)	0.61
43. I don't like how this device shows membership to a certain social group. (R)	0.60
21. This device could allow its wearer to take advantage of people. (R)	0.59
17. The wearer of this device could be considered rude. (R)	0.56
48. People would not be offended by the wearing of this device.	0.51
35. This device could cause health concerns. (R)	0.46

R=Reverse scored

5.2.3 Coefficient Alpha

After discarding the items that did not clearly load on a single factor, coefficient alpha (or Cronbach's alpha, Cronbach, 1951) is used to evaluate how well the weeding-out process worked. Coefficient alpha is a function of both the number of items and their magnitude of intercorrelation (Spector, 1992). Nunnally and Bernstein (1994) considered 0.70 an acceptable lower bound for coefficient alpha, although scales with lower alphas have been published. DeVellis (2012) considered a minimally acceptable alpha to be 0.65. Therefore, in the development of the WEAR Scale, an alpha below 0.65 will be considered unacceptable.

The alpha on the 31 items that loaded significant on one factor was 0.93. The alpha on the 23 items of Component 1 was 0.95, and the alpha on the 8 items of Component 2 was 0.77.

5.3 Adjust Scale Length

At this point of the process, the WEAR Scale consists of a pool of 31 items, made up of two components, each of which show acceptable reliability (alpha). Alpha is a reflection of both the covariation among the items and the total number of items, and typically attention is now turned toward balancing brevity and reliability. However, because WEAR 2.1 (50 items) was later administered using different wearable devices in Study 4 for purposes of comparison, further adjustments of these 31 items was delayed.

5.4 Test Construct Validity of the 31-item WEAR Scale

Now that extraction and rotation has demonstrated a well-performing and reliable 31-item WEAR Scale, this version was used to test the hypotheses that were predicted. Rejection of null hypotheses provide evidence for the construct validity of the 31-item WEAR Scale.

5.4.1 Methods

An initial attempt to validate a scale is accomplished by conducting studies to test the hypotheses about the scale and is done following item analysis to select scale items (Spector, 1992). The scale produced from factor analysis and other analyses described above was now used to test the relationships that were hypothesized in Section 4.2, namely:

1. A positive relationship between affinity for technology and acceptability of wearables (31-item WEAR).

2. A positive relationship between likeableness rating and social acceptability of wearables (31-item WEAR).

3. A negative relationship between age and social acceptability of wearables (31-item WEAR).

4. A positive relationship between optimism and social acceptability of wearables (31-item WEAR).

Yildirim and Correia (2015)'s validation of their "no mobile phone phobia" or nomophobia measure (NMP-Q) provides an example of a similar validation methodology. In that study, they included the 8-item Mobile Phone Involvement questionnaire (MPIQ) when administering the NMP-Q, to check the construct validity of the NMP-Q. They computed the Pearson product-moment correlation coefficient between the two measures, to evaluate their relationship. Their finding of a strong and direct correlation between the scores of the NMP-Q and the MPIQ led them to conclude that the NMP-Q possessed construct validity. Similarly, finding the relationships hypothesized in one through four above will present a strong argument for the construct validity of the WEAR Scale.

5.4.2 Results

Table 30 presents the correlation matrix for the testing of the hypotheses stated above. Table 31 shows the hypothesized and actual relationships between the 31-item WEAR scale (a measures of social acceptability of a wearable) and the validity measures. Also shown here are the correlations among the 31-item WEAR and its two components.

Table 30.

Correlations among the variables

Measure	WEAR 31 items	WEAR C1 23 items	WEAR C2 8 items	Affinity for Technology	Likableness Rating	Age
WEAR - 31 items	--					
WEAR C1 – 23 items	0.97**	--				
WEAR C2 – 8 items	0.46**	0.21**	--			
Affinity for Tech	0.08	0.03	0.21**	--		
Likableness Rating	0.69**	0.63**	0.42**	0.14*	--	
Age	-0.09	-0.07	-0.11	-0.09	-0.08	--
Self-rated Optimism	0.11	-0.12	0.00	0.20**	0.16*	0.01

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 31.

Hypothesized and actual relationships between 31-item WEAR and validity measures

Measure	Hypothesized	Results
Affinity for technology	Positive	Not significant (p>.05), but positive (p<.01) for C2
Likeableness	Positive	Positive (p<.01)
Age	Negative	Not significant (p>.05)
Optimism	Positive	Not significant (p>.05)

Although a positive relationship between affinity for technology and acceptability of wearables was hypothesized, the correlation was not significant for the 31 items, but there was a small correlation (r = 0.21, p < .01) with Component 2. While the null hypothesis (that there is no relationship) cannot be rejected, there is evidence that affinity for technology relates to a lack of social fears about wearing a device.

The hypothesis of a positive relationship between likeableness rating and acceptability of wearables was strongly supported ($r = 0.69$, $p < .01$). The null hypothesis (that there is no relationship) is rejected, and WEAR validity is supported by this result.

While a negative relationship between age and acceptability of wearables was hypothesized, the correlation was not significant. The hypothesis of a positive relationship between optimism and acceptability of wearables was also not supported.

Thus, one of the four hypotheses was strongly supported, and all will be re-tested in Study 4 with a larger sample along with additional validation measures. Using an ANOVA model, rather than correlations, produced similar results. One issue with regard to age was a lack of variability; support for the hypothesis may rest on a more diverse sampling of ages.

Validation is an ongoing process, as continued research and validation is necessary to evidence usefulness of a concept or construct (Clark & Watson, 1995; Spector, 1992). Over time, researchers collect evidence to support validity and thus gain confidence that the scale measures the theoretical construct it is supposed to be measuring (Spector, 1992). As ongoing evidence of validation is gathered, hypotheses are formed about causes, effects, and correlates of the construct. Researchers use the scale to test these hypotheses, and this empirical support for the hypotheses is what results in validity of the scale (Spector, 1992). Therefore, confirmation of one of the four hypotheses provides initial evidence of construct validity and suggests usefulness of the construct “social acceptability of a wearable device.” Over time and with further testing, the construct may then exhibit usefulness. “A useful construct is part of a theoretical system of relations with other constructs that may explain, predict, and lead to control over phenomena of interest” (Spector, 1992, p. 47).

Because the final WEAR Scale will be used in reference to a wide range of devices, it is important to conduct factor analysis on more than one device. Next, Study 4 repeats the methodology of Study 3, but with Apple Watch and Google Glass.

CHAPTER 6

STUDY 4 AND RELATED DEVELOPMENT

6.1 Administer Items (Apple Watch and Google Glass 2 Stimuli)

Study 3 administered WEAR v.2.1 and validation items/scales to the target population using a Bluetooth Headset as the stimulus object. Study 4 uses the same pool of 50 items to test two additional stimulus objects within participants, Apple Watch and Google Glass 2 (hereinafter "Google Glass"). Additionally, eleven items related to adoption of technology and personality were added to the existing validation measures, to augment prior validation efforts.

6.1.1 Methods

Developing a scale that measures a person's attitude about a particular stimulus object (rather than a general attitude) presents unique challenges. Because participants must be shown a particular stimulus, the question arises whether a scale developed using a certain stimulus is generalizable to other related stimuli. Marketing research has grappled with this issue, as the discipline seeks to measure, e.g., what consumers think about various brands or how they feel about different ads they see. In this vein, Newell and Goldsmith (2001) developed a scale to measure perceived corporate credibility of various corporations. Their process is informative about how to handle similar scale development issues herein.

In Newell and Goldsmith (2001)'s first study, they asked participants to rate Exxon and IBM, which were previously rated to have low and high credibility, respectively. The rotation procedure yielded four factors for the Exxon data and five factors for the IBM data. They then dropped items that loaded below 0.50, which resulted in an identical two-factor solution for both data sets. They found that "a two-factor, eight-item solution revealed the most distinct and meaningful components," and used these items as the provisional corporate credibility scale that was evaluated in further studies (Newell & Goldsmith, 2001, p. 239). In a later study, the scale maintained the two-factor structure across a variety of companies, with the items repeatedly loading on the same factors and showing a high internal consistency (0.85 to 0.92). Given the similar nature of the WEAR's development process, in that a similar consistency should be demonstrated across various wearables, Study 4 compared two devices within subjects. One device (Apple Watch) is quite similar to a common wristwatch, while the other device (Google Glass) is more controversial as a head-worn device, which in its first incarnation received a fair amount of criticism (as discussed in Chapter 2). Similar to Newell and Goldsmith's methodology, a scale is sought that maintains the same-factor solution across the three wearables' datasets (the original Bluetooth headset and the two additional ones).

Again the invitation email was sent to the Iowa State University list of all students, and participants were required to be age 18 to 30 because this is the population for which the scale is being developed. In the recruitment email, it was explained that at the end of the study, participants could enter their name/email into a random drawing for one of five $50 Amazon.com gift certificates.

Potential participants who wished to participate clicked on a link in the recruitment email that then took them to the informed consent (approved by the Institutional Review Board under IRB 15-647 per modification, Appendix G), after which they responded to the study questions in a Qualtrics web-based survey. Because two devices were being tested in Study 4, and also because validation items pertaining to adoption were added, the number of items totaled 127. So that participants would not fatigue from answering 127 questions in one survey, they were provided 63 questions in the Apple Watch survey (50 WEAR items, 1 optimism item, 3 adoption items, 8 personality items, and 1 likeability item) and 66 questions in the Google Glass survey (50 WEAR items, 5 demographic items, 10 affinity for technology items, and 1 likeability item), administered one week apart. To control for order effects, about half the participants rated Apple Watch first (Table 32), and about half rated Glass first (Table 33), as randomly assigned by the survey application.

Table 32.

Wearable Stimuli for Study 4: Apple Watch

This is a wearable device that is worn like a wristwatch. Its functions are similar to what is available on a smartphone, like receiving and responding to notifications, tracking daily activity, controlling music play, getting directions, or paying for a purchase.

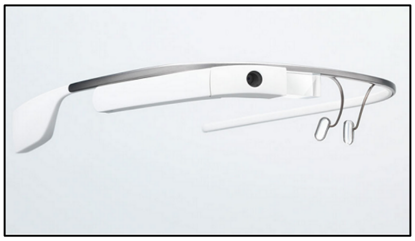
http://www.apple.com/shop/buy-watch/apple-watch-sport

http://www.macworld.co.uk/how-to/apple/guide-phone-calls-on-apple-watch-3607555/
http://www.theverge.com/2014/9/9/6124253/apple-watch-hands-on-video-photos

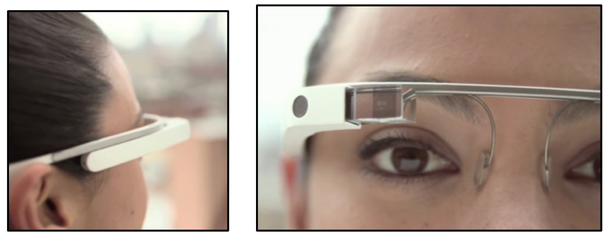
Table 33.

Wearable Stimuli for Study 4: Google Glass

This is a wearable device that is worn like eyeglasses. A small screen displays information similar to what is available on a smartphone, like the weather, a calendar, or an upcoming flight. The user can also view text messages, videos, and photos, as well as take photos and video.



http://www.pcadvisor.co.uk/feature/gadget/google-glass-release-date-uk-price-specs-3436249/



http://fortune.com/2015/12/28/new-google-glass/

6.1.2 Additional Items or Scales for Validation Purposes

The validation items from Study 3 were repeated in Study 4. Additionally, 11 items were added, because only the likeability validation item in the Bluetooth headset dataset provided a strong case for construct validity. The additional 11 items are hypothesized to relate to the WEAR Scale as follows:

1. *I am eager to adopt new technology* (Likert scale from strongly agree to strongly disagree). The hypothesis is that early adopters will be positively correlated with the WEAR Scale, because people who find a wearable more acceptable would be more likely to be early adopters of technology.

2. *How many wearable devices do you own?* The hypothesis is that wearable ownership will be positively correlated with the WEAR Scale, because people who find a wearable more acceptable would be more likely to own a wearable(s) themselves.

3. *How long have you owned your current mobile phone?* The hypothesis is that the age of one's mobile phone is negatively correlated with the WEAR Scale, because later adopters would be less likely to find a wearable socially acceptable.

4.-11. *Agreeableness and Intellect/Imagination.* Rogers' (2003) research on personality variables associated with early adopters and innovativeness provides further suggestions for validation. Some generalizations Rogers reported about early adopters, as compared to late adopters, is that early adopters may be less dogmatic, have greater empathy, have a greater ability to deal with abstractions, have greater rationality and intelligence, have a more favorable attitude toward change, and may be better at coping with uncertainty. These personality characteristics are hypothesized to be positively correlated with the WEAR Scale. The Mini-IPIP Scales (Donnellan, Oswald, Baird, & Lucas, 2006), with four items for each of the Big Five factors of personality (Goldberg, 1999), provide a brief and useful measure of the factors of agreeableness and intellect/imagination, which are hypothesized to be positively correlated with the WEAR Scale. Table 34 shows the 8 items from the 20-Item Mini-IPIP that measure these two factors.

Table 34.

Mini-IPIP items to test construct validity in Study 4

Factor	Item (1-to-5 scale, very inaccurate to very accurate)
Agreeableness	Sympathize with others' feelings
	Am not interested in other people's problems. (Reverse scored)
	Feel others' emotions.
	Am not really interested in others. (Reverse scored)
Intellect/Imagination	Have a vivid imagination.
	Am not interested in abstract ideas. (Reverse scored)
	Have difficulty understanding abstract ideas. (Reverse scored)
	Do not have a good imagination. (Reverse scored)

6.1.3 Results

Three hundred thirty-five participants submitted both surveys. For the Apple Watch survey, the time taken to submit the survey ranged from 2 to 444 minutes, with a mean of 10.02 minutes and a standard deviation of 26.54 minutes. For the Glass survey, the time taken to submit the survey ranged from 2 to 366 minutes, with a mean of 10.56 minutes and a standard deviation of 25.81 minutes. Omitted from data analysis were 17 participants who spent less than 4 minutes on each survey. Twelve other participants' data were omitted – two whose ages were not in the 18-to-30 range, and ten who skipped one or more WEAR items. Missing values in the validation items were excluded pairwise from those analyses.

Thus, data from 306 participants were used. All 306 participants used in the data analysis were aged 18 to 30. The mean age was 20.91 (N=306; SD=2.17). Further demographics are reported in Table 35.

Table 35.

Demographics of 306 participants

		N	%
Gender	Male	127	41.5%
	Female	173	56.5%
	Other or unanswered	6	2.0%
Ethnicity	Hispanic or Latino	18	5.9%
	Not Hispanic or Latino	288	94.1%
Race	American Indian or Alaska Native	2	0.7%
	Asian	24	7.8%
	Black or African American	5	1.6%
	Native Hawaiian or other Pacific Islander	0	0.0%
	White	271	88.6%
	Unanswered	4	1.3%
Education	High school graduate	17	5.5%
	Some college	234	76.5%
	College graduate	17	5.6%
	Some graduate work	29	9.5%
	Masters, Ph.D., or other advanced degree	8	2.6%
	Unanswered	1	0.3%

Table 36 and Table 37 present the summary item statistics for each of the devices tested. Cronbach's alpha for WEAR v.2.1 – Apple Watch was 0.96. Cronbach's alpha for WEAR v.2.1 – Google Glass was 0.96.

Table 36.

Summary Item Statistics for WEAR v.2.1 – Apple Watch

	Mean	Minimum	Maximum	Range	Variance
Item Means	4.31	2.30	5.24	2.94	0.32
Item Variances	1.16	0.62	1.93	1.31	0.10

Table 37.

Summary Item Statistics for WEAR v.2.1 – Google Glass

	Mean	Minimum	Maximum	Range	Variance
Item Means	3.19	1.79	4.43	2.63	0.25
Item Variances	1.47	0.92	2.13	1.21	0.09

6.2 Evaluate the Items

As was done in Study 3 in evaluating the items, first an initial assessment was conducted to identify and remove any obviously problematic items and assess whether those data were appropriate for factor analysis.

6.2.1 Initial assessment

Following administration, the next step was to assess the performance of the initial pool of items (v.2.1) with regard to Apple Watch and Google Glass. As discussed in Chapter 2, the most important quality of an item is a high correlation with the true score of the latent variable (DeVellis, 2012), which is evidenced by a high correlation of the scale items.

6.2.2.1 Methods and Results

In assessing the performance of the pool of items (v.2.1), first the correlation matrix was used to examine correlations between items (DeVellis, 2012). Corrected item-total correlations are shown in Table 38. Because the objective of this item analysis was to remove items that do not contribute to an internally consistent scale (Spector, 1992), the one item with a negative correlation was removed, item 19. This was also the single item that had a negative correlation in Study 3, and was similarly removed from further analysis.

Table 38.

Corrected Item-Total Correlations for Apple Watch and Google Glass

Item	Item-Total Correlations Apple Watch	Item-Total Correlations Google Glass
1. I think my peers would find this device acceptable to wear.	0.56	0.73
2. The size of this device is conveniently small.	0.52	0.53
3. This device is like the clothing and accessories typically worn in our society.	0.54	0.59

Table 38. continued

Item	Item-Total Correlations Apple Watch	Item-Total Correlations Google Glass
4. This device looks natural and not out of place on the body.	0.64	0.69
5. This device could make people uncomfortable. (R)	0.47	0.47
6. This device is consistent with my self-image.	0.67	0.69
7. This device seems to be useful and easy to use.	0.62	0.61
8. The way this device displays membership to a certain social group is appealing.	0.47	.057
9. I like what this device communicates about its wearer.	0.65	0.72
10. A wearer of this device would be keeping to the social norms we need to stick to.	0.50	0.63
11. This device might be considered disfiguring to its wearer. (R)	0.51	0.57
12. This device seems creepy. (R)	0.69	0.73
13. This device seems like "too much" technology. (R)	0.60	0.62
14. This device might restrict movement or physically get in the way. (R)	0.40	0.42
15. This device is fashionable.	0.71	0.73
16. This device seems comfortable, not bulky.	0.65	0.60
17. The wearer of this device could be considered rude. (R).	0.49	0.53
18. This device symbolizes something undesirable. (R)	0.68	0.69
19. There has been a lot of media buzz about this device. (R)	-0.24	-0.13
20. This device is cool.	0.72	0.70
21. This device could allow its wearer to take advantage of people. (R)	0.45	0.38
22. I can imagine that people would be interested in this device and would not have a problem wearing it.	0.51	0.61
23. This device is sleek, not clunky.	0.62	0.58
24. This device seems to offer options for personalization, so that everyone is not wearing the "same thing."	0.46	0.42

Table 38. continued

Item	Item-Total Correlations Apple Watch	Item-Total Correlations Google Glass
25. This device could help people.	0.43	0.47
26. This device would be generally accepted by the vast majority of people.	0.66	0.71
27. This device is not weird.	0.79	0.83
28. The wearer of this device would not be judged negatively by others.	0.59	0.58
29. This device is similar to existing acceptable devices or accessories.	0.49	0.50
30. Wearing this device could be considered inappropriate. (R)	0.56	0.57
31. This device could be considered a normal part of life.	0.64	0.71
32. Use of this device could hurt the wearer's social reputation. (R)	0.61	0.64
33. This device would be distracting when driving. (R)	0.35	0.45
34. This device seems fairly common.	0.48	0.42
35. This device could cause health concerns. (R)	0.44	0.28
36. Use of this device raises privacy issues. (R)	0.44	0.39
37. I could imagine aspiring to be like the wearer of such a device.	0.60	0.68
38. There is no chance of being ridiculed when wearing this device.	0.54	0.56
39. Use of this device would be more threatening than exciting. (R)	0.58	0.59
40. This device is stylish.	0.72	0.74
41. This device's placement on the body could cause awkwardness or embarrassment. (R)	0.49	0.56
42. Wearing this device would cause no reaction, or a neutral reaction, from other people.	0.21	0.53
43. I don't like how this device shows membership to a certain social group. (R)	0.48	0.41
44. This device is goofy. (R)	0.68	0.67

Table 38. continued

Item	Item-Total Correlations Apple Watch	Item-Total Correlations Google Glass
45. This device would enhance the wearer's image.	0.49	0.67
46. The wearer of this device would get a positive reaction from others.	0.65	0.73
47. This device is aesthetically pleasing.	0.71	0.71
48. People would not be offended by the wearing of this device.	0.54	0.58
49. This device seems like it would be annoying or add confusion to the typical interactions of people. (R)	0.62	0.69
50. The majority of people probably think this device is OK to wear in public.	0.58	0.64

Item means ranged from 2.23 to 5.24, with a mean of 4.31 on the Apple Watch survey. Item means ranged from 1.79 to 4.43, with a mean of 3.19 on the Google Glass survey. As desired, the mean of the item means for Google Glass was very close to the center of the scale (3.50). However, for Apple Watch, the mean of the item means was somewhat higher than desired, which is not unexpected given that Apple Watch rather closely resembles a common wristwatch.

For the Apple Watch survey, item variances ranged from 0.62 to 1.93, with a mean of 1.16. For the Google Glass survey, item variances ranged from 0.92 to 2.13, with a mean of 1.47. These demonstrate reasonable variability. Factor analysis then proceeded with 49 items for each survey.

6.2.2 Factor Analysis

6.2.2.1 Methods and Results

Extraction.

The technique of principal components analysis (PCA) was used to examine whether the remaining 49 items measure a single construct of "social acceptability of wearable," or whether multiple constructs underlie the two sets of items. SPSS Version 23 was used to conduct PCA using extraction and rotation instructions provided by Pallant (2007). Furthermore, Pallant (2007) recommended some measures that can be generated in SPSS to assess the factorability of the data: Bartlett's test of sphericity, which should be significant at $p < .05$, and the Kaiser-Meyer-Olkin measure of sampling adequacy, which should be 0.6 or above. For Apple Watch, Bartlett's test of sphericity was significant at $p < 0.001$, and the Kaiser-Meyer-Olkin measure of sampling adequacy value was 0.95. For Google Glass also, Bartlett's test of sphericity was significant at $p < 0.001$, and the Kaiser-Meyer-Olkin measure of sampling adequacy value was 0.95. These 49 items were therefore clearly factorable in both instances.

Factor extraction was then used to determine the fewest number of factors that can represent the relationships among the variables (Pallant, 2007). As in Study 3, the most common technique, PCA, was used, with the techniques of Kaiser's criterion (Kaiser, 1960), Scree test (Catell, 1966), and parallel analysis (Horn, 1965) (see also Pallant, 2007). Each is considered in turn below.

Using Kaiser's criterion (Kaiser, 1960), the Total Variance Explained (Table 39) provided the Initial Eigenvalues for the components with Eigenvalues greater than 1.0. For the Apple Watch survey, the first nine components recorded eigenvalues above 1.0, and explained a total of 62.06 percent of the variance. For the Google Glass survey, the first eight components recorded eigenvalues above 1.0, and explained a total of 63.26 percent of the variance.

Table 39.

Total Variance Explained

Apple Watch			**Google Glass**		
	Initial Eigenvalues			Initial Eigenvalues	
Component	Total	Percent of Variance	Component	Total	Percent of Variance
1	17.36	35.43	1	19.25	39.29
2	3.47	7.09	2	3.01	6.14
3	1.91	3.90	3	2.14	4.37
4	1.80	3.67	4	1.87	3.81
5	1.37	2.80	5	1.29	2.62
6	1.22	2.50	6	1.26	2.57
7	1.15	2.35	7	1.13	2.30
8	1.20	2.24	8	1.06	2.16
9	1.03	2.11			

The scree plots for Apple Watch (Figure 6.) and Google Glass (Figure 7.) do not have a clear elbow. Both could be supportive of either a two-factor solution or perhaps four-factor solution, with Google Glass being more suggestive of a four-factor solution.

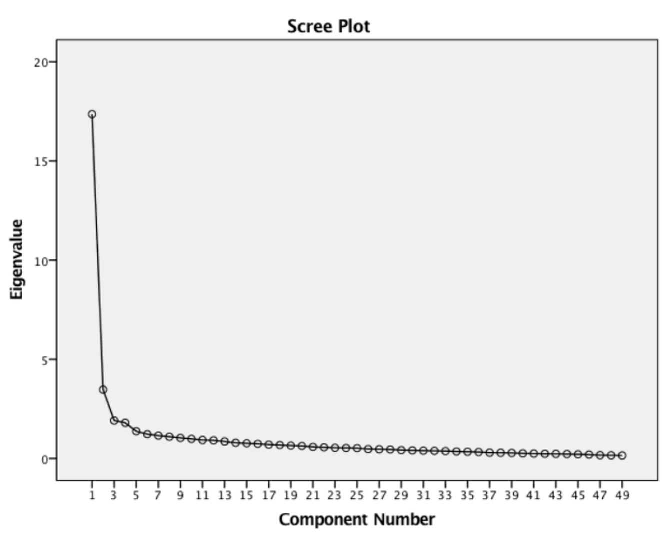


Figure 6. Scree Plot – Apple Watch

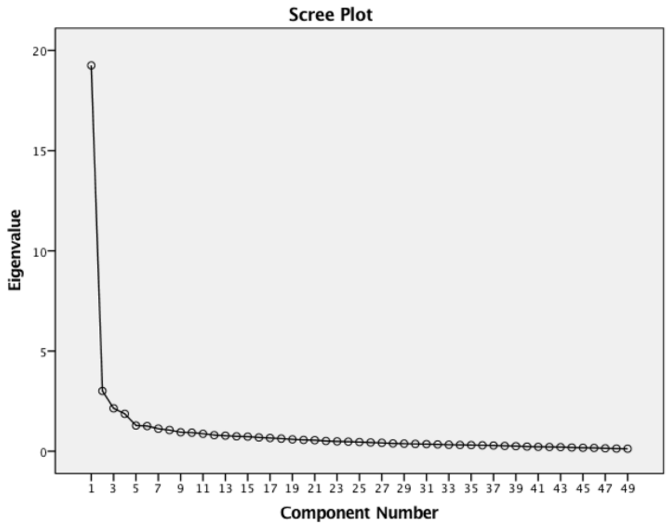


Figure 7. Scree Plot – Google Glass

The results of parallel analysis, using the maximum number of replications (1000), are shown in Figure 8. For Apple Watch, eigenvalues one through four obtained in SPSS (17.36, 3.47, 1.91, 1.80) exceeded the first four random eigenvalues in parallel analysis (1.87, 1.78, 1.71, 1.65), therefore, parallel analysis suggested retaining Components 1 through 4 for a four-factor solution. For Google Glass, eigenvalues one through four obtained in SPSS (19.25, 3.01, 2.14, 1.87) also exceeded the first four random eigenvalues in parallel analysis, therefore, parallel analysis suggested retaining Components 1 through 4 for a four-factor solution for Google Glass as well.

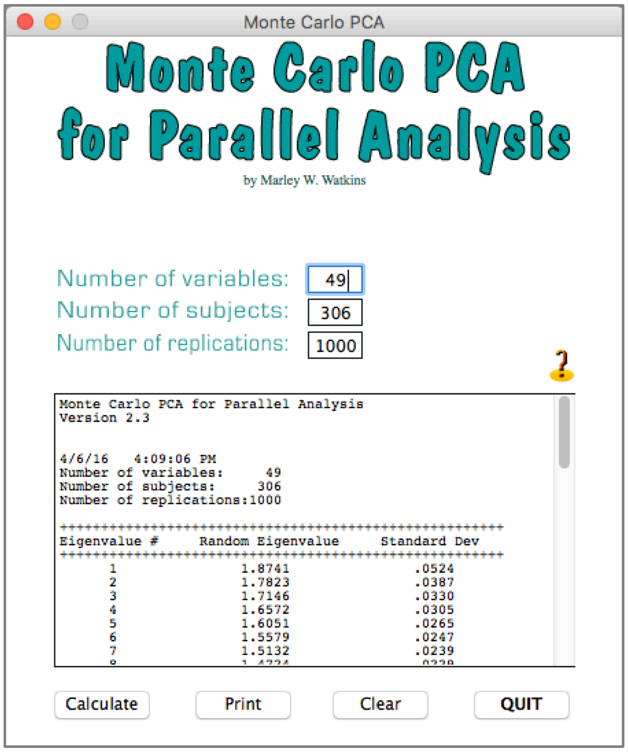


Figure 8. Output from Parallel Analysis

The component matrix provides the unrotated loadings on each of the components (Pallant, 2007). For Apple Watch, all of the items that loaded on Components 5 through 9 also loaded on either Component 1 through 4. The Pattern Matrix reported that rotation failed to converge in 25 iterations for the rotated nine-factor solution. For Google Glass, all of the items that loaded on Components 5 through 8 also loaded on either Component 1 through 4. The pattern matrix reported that rotation failed to converge in 25 iterations for the rotated eight-factor solution. Therefore, the component matrices and pattern matrices further suggest that eight- or nine-factor solutions are not appropriate, and that a lesser-factor solution should be used.

Rotation.

Based on the extraction results above, four factors will be retained because 1) both of the scree plots, as well as the parallel analysis, suggest a four-factor solution, 2) Kaiser's criterion has been criticized for retaining too many factors, 3) the Component Matrix and Pattern Matrix suggest that an eight- or nine-factor solution is not appropriate, and 4) parsimony is favored in factor retention. Next considered is factor rotation of a four-factor solution for each of the surveys.

As in Study 3, the Direct Oblimin (oblique) rotation procedure was conducted next. For Apple Watch, the percentage of variance explained by this four-factor solution was 50.08 percent (compared to 62.06 percent explained by the nine-factor solution); the Component Correlation Matrix showed the strength (absolute values) among the four factors ranging from 0.28 to 0.41, with a mean of 0.34. For Google Glass, the percentage of variance explained by this four-factor solution was 53.62 percent (compared to 63.26 percent explained by the eight-factor solution); the Component Correlation Matrix showed the strength (absolute values) among the four factors ranging from 0.07 to 0.55, with a mean of 0.30. Lower correlations in the Component Correlation Matrix (below 0.3 according to Pallant, 2007; below 0.32 according to Tabachnick and Fiddell, 2007) mean that orthogonal rotation should be used. However, if the correlations are low, the results of orthogonal and Oblimin yield similar results, but if the correlations are higher, Oblimin is the proper choice (Pallant, 2007). Therefore, because the correlations do not provide any clear choice, Oblimin rotation was used.

In the Pattern Matrix resulting from Oblimin rotation, the highest loading items on each component were used to identify the component (Table 40. and Table 41.). Bolded coefficients loaded 0.30 or greater on their primary component and less than 0.30 on all other components.

Table 40.

Apple Watch Pattern Matrix for PCA with Oblimin Rotation of Four-Factor Solution of 49 WEAR Items

Item - Category*	Component 1**	Component 2**	Component 3**	Component 4**
9. Like what it communicates - SI	**0.77**			
8. Like group membership – SI	**0.77**			
37. Aspire to be like wearer – SI	**0.71**		-0.16	
46. Positive reaction others – OR	**0.64**			0.23
45. Enhance wearer’s image – SI	**0.56**	-0.19	-0.23	0.13
6. Consistent with self-image - SI	**0.56**	0.13	-0.24	
20. Cool - J	**0.55**		-0.35	
10. Keeping to social norms - N	**0.53**			0.31
43. Don’t like group (R) - SI	0.51	0.39	0.20	
7. Useful and easy to use - J	**0.47**		-0.23	0.13
18. Symbolizes undesirable (R) – J	0.44	0.43		0.11
25. Could help people – C	**0.39**	0.11	-0.23	-0.11
21. Wearer could take advantage of people (R) - C	-0.19	**0.71**	-0.10	
36. Raises privacy issues (R) - C		**0.71**		
30. Could be inappropriate (R) - N		**0.68**		0.16
35. Could cause health concerns (R) - E	0.12	**0.67**		-0.13
17. Could be rude (R) - C		**0.66**		0.15
39. Threatening not exciting (R) – C	0.11	**0.58**		
12. Seems creepy (R) - J	0.13	**0.56**	-0.20	0.10
48. People not offended - OT		**0.54**		0.27
49. Annoying/add confusion (R) - C	0.17	**0.54**	-0.14	
13. Seems like too much tech (R) – J	0.29	**0.54**	-0.11	
33. Would be distracting when driving (R) – C		**0.47**	-0.17	
5. Make uncomfortable (R) – C	-0.15	0.46		0.30
32. Could hurt reputation (R) - C	0.19	0.44		0.35
41. Body placement awkward - C		**0.40**	-0.19	0.17
16. Comfortable not bulky – E		0.17	**-0.81**	-0.17
23. Sleek not clunky - A			**-0.77**	
4. Natural on body – E			-0.66	0.35
40. Stylish - A	0.32		-0.63	
47. Aesthetically pleasing – A	0.36		-0.58	
15. Fashionable – A	0.30		-0.57	0.12
2. Conveniently small – E			**-0.51**	0.15
44. Goofy (R) - A	0.26	0.29	**-0.45**	
14. Might restrict movement (R) - E	-0.23	0.35	-0.42	
24. Option for personalization – A	0.22	0.18	**-0.42**	
27. Not weird - Q	0.27	0.32	-0.37	0.18
29. Similar to existing - AO			-0.14	**0.57**
50. OK to wear in public - OT	0.17	0.26		**0.57**
34. Seems fairly common – N	0.12		0.18	**0.51**
26. Generally accepted- OR	0.40			0.51
3. Like typical clothing - N		-0.18	-0.43	0.50
1. Peers find acceptable – OT	0.22		-0.20	**0.49**
42. No/neutral reaction – OR	-0.21	0.13		**0.49**
28. Not judged negatively – OT	0.23	0.26		**0.43**
31. Normal part of life - N	0.30	0.17	-0.16	0.36
38. No chance of ridicule – OR	0.24	0.27		0.34
11. Might be disfiguring (R) – A		0.31	-0.17	0.32

Table 40. continued

Item - Category*	Component 1**	Component 2**	Component 3**	Component 4**
22. Interested in/no problem – N	0.20	0.10	-0.18	**0.32**

R=Reverse scored
*Category key: A=Aesthetics; AO=Available/Ordinary; C=Consequences; E=Ergonomics; J=Judgment; N=Norms; OR=Others' Reactions; OT=Others' Thoughts; SI=Self-Identity; Q=Qualities of the Device or Wearer
**Loadings=>0.10.

Table 41.

Google Glass Pattern Matrix for PCA with Oblimin Rotation of Four-Factor Solution of 49 WEAR Items

Item - Category*	Component 1**	Component 2**	Component 3**	Component 4**
37. Aspire to be like wearer – SI	**0.83**			
9. Like what it communicates - SI	**0.82**			
20. Cool - J	**0.79**			0.12
25. Could help people – C	**0.76**			-0.13
6. Consistent with self-image – SI	**0.65**			0.25
8. Like group membership – SI	**0.64**		-0.24	
45. Enhance wearer's image – SI	**0.59**		-0.21	0.11
31. Normal part of life – N	**0.56**	0.14	-0.16	0.13
13. Seems like too much tech (R) – J	0.55	0.13	0.34	0.20
7. Useful and easy to use – J	**0.54**			0.28
10. Keeping to social norms - N	0.53		-0.18	0.10
46. Positive reaction others – OR	**0.51**	0.28	-0.28	
18. Symbolizes undesirable (R) – J	0.50	0.31	0.24	0.15
27. Not weird – Q	**0.48**	0.25	-0.15	0.28
39. Threatening not exciting (R) – C	0.47	0.37	0.21	
44. Goofy (R) – A	0.43			0.43
1. Peers find acceptable – OT	0.43		-0.31	0.28
49. Annoying/add confusion (R) – C	**0.42**	0.26		0.22
22. Interested in/no problem – N	**0.37**		-0.27	0.25
24. Option for personalization – A	0.21		-0.18	0.21
36. Raises privacy issues (R) – C	-0.14	**0.76**		
30. Could be inappropriate (R) – N		**0.75**		0.11
21. Wearer could take advantage of people (R) – C	-0.21	**0.74**		
17. Could be rude (R) – C	0.17	**0.72**	0.13	-0.12
48. People not offended - OT	0.16	**0.71**		
5. Make uncomfortable (R) – C		**0.65**		
32. Could hurt reputation (R) – C		**0.55**	-0.16	0.19
12. Seems creepy (R) - J	0.33	0.47		0.18
38. No chance of ridicule – OR		0.46	-0.39	0.13
50. OK to wear in public – OT	0.31	0.45	-0.29	
42. No/neutral reaction – OR		0.41	-0.38	0.12
33. Would be distracting when driving (R) – C	0.18	**0.39**	0.20	0.11
26. Generally accepted- OR	0.32	0.38	-0.36	
28. Not judged negatively – OT	0.28	**0.38**	-0.23	
35. Could cause health concerns (R) – E	0.24	0.31	0.48	
29. Similar to existing – AO	0.18	0.19	**-0.47**	0.13
34. Seems fairly common – N	0.14	0.23	**-0.43**	
43. Don't like group (R) - SI	0.23	0.20	**0.31**	0.21

Table 41. continued

Item - Category*	Component 1**	Component 2**	Component 3**	Component 4**
16. Comfortable not bulky – E				**0.83**
23. Sleek not clunky - A			-0.13	**0.76**
14. Might restrict movement (R) – E	-0.17	0.10	0.33	0.75
2. Conveniently small – E			-0.12	**0.65**
4. Natural on body – E	0.15		-0.31	0.60
11. Might be disfiguring (R) – A		0.18		**0.57**
15. Fashionable – A	0.39		-.10	0.54
47. Aesthetically pleasing – A	0.33		-0.11	0.53
41. Body placement awkward - C		0.24		**0.53**
40. Stylish - A	0.43		-0.11	0.51
3. Like typical clothing - N	0.13		-0.39	0.45

R=Reverse scored
*Category key: A=Aesthetics; AO=Available/Ordinary; C=Consequences; E=Ergonomics; J=Judgment; N=Norms; OR=Others' Reactions; OT=Others' Thoughts; SI=Self-Identity; Q=Qualities of the Device or Wearer
**Loadings=>0.10.

The most obvious items to remove at this point were be those with communalities less than 0.30, however, all communality values for both surveys exceeded 0.30. The next step was to identify items that loaded significantly at 0.30 or greater (Hair, Tatham, Anderson, & Black, 1998) on the same components (factors) across both surveys. For components 3 and 4, no items loaded significantly on the same factor for both surveys. Eight items loaded significantly on Component 1 on both surveys (6, 7, 8, 9, 25, 37, 45, 46) and six items loaded significantly on Component 2 on both surveys (17, 21, 30, 33, 36, 48). Revisiting the Bluetooth two-factor solution, we see that all of these items but one (no. 33) loaded significantly.

The next step, therefore, was to subject these fourteen items to a two-factor solution for all three devices (Table 42). As reported in the validation section below, the correlation of the two factors is 0.34 for Apple Watch and 0.45 for Google Glass, so the Oblimin method was used. The correlation of the two factors (14 items) for the Bluetooth Headset was 0.20, however, so both Oblimin and Varimax loadings are reported. A lower correlation (below 0.3 according to Pallant, 2007; below 0.32 according to Tabachnick and Fiddell, 2007) means that orthogonal rotation (Varimax method) should be used, but Oblimin is also reported since the other two devices used this method. Thus, this two-factor, fourteen-item solution was proposed as the best solution at this stage of analysis.

Table 42.

Loadings for 14-item, 2-Factor Solution Across Three Devices

Factors and Items	Apple Watch Pattern Matrix Loadings Oblimin	Google Glass Pattern Matrix Loadings Oblimin	Bluetooth Headset Pattern Matrix Loadings Oblimin	Bluetooth Headset Rotated Component Matrix Loadings Varimax
Factor 1:				
6. This device is consistent with my self-image.	0.70	0.78	0.77	0.77
7. This device seems to be useful and easy to use.	0.65	0.73	0.61	0.62
8. I like how this device shows membership to a certain social group.	0.80	0.73	0.68	0.68
9. I like what this device communicates about its wearer.	0.82	0.82	0.77	0.77
25. This device could help people.	0.50	0.66	0.49	0.49
37. I could imagine aspiring to be like the wearer of such a device.	0.79	0.84	0.77	0.76
45. This device would enhance the wearer's image.	0.77	0.73	0.74	0.73
46. The wearer of this device would get a positive reaction from others.	0.78	0.73	0.73	0.73
Factor 2:				
17. The wearer of this device could be considered rude. (R)	0.77	0.71	0.71	0.72
21. This device could allow its wearer to take advantage of people. (R)	0.77	0.83	0.70	0.68
30. Wearing this device could be considered inappropriate. (R)	0.74	0.76	0.66	0.68
33. This device would be distracting when driving. (R)	0.55	0.43	0.34	0.34
36. Use of this device raises privacy issues. (R)	0.69	0.80	0.72	0.71
48. People would not be offended by the wearing of this device.	0.64	0.66	0.48	0.50

R=Reverse scored

5.2.3 Coefficient Alpha

As discussed previously, in the development of the WEAR Scale, an alpha must be at least 0.65 to be considered acceptable. The alpha on the 14 items was 0.86 on the Apple Watch survey, with the alpha on the 8 items of Component 1 at 0.88, and the alpha on the 6 items of Component 2 at 0.79. The alpha on the 14 items was 0.88 on the Google Glass survey, with the alpha on the 8 items of Component 1 at 0.89, and the alpha on the 6 items of Component 2 at 0.82. Revisiting the Bluetooth Headset survey (Study 3) shows the alpha on the 14 items to be 0.79, with the alpha on the 8 items of Component 1 at 0.85, and the alpha on the 6 items of Component 2 at 0.68. The alpha requirement has been met for each of the three devices on the full scale as well as the components.

6.3 Adjust Scale Length and Final Scale

At this point in a scale's development, DeVellis (2012) recommends adjusting the scale to balance brevity and reliability, if needed. As reported above, Cronbach's alpha is very good, averaging 0.84 for the full scale across the three devices (DeVellis, 2012; Nunnally & Bernstein, 1994). The other type of reliability to address is split-half reliability. Split-half reliability methods can achieve much the same estimations of alternate forms, and is obtained via the Spearman-Brown formula. The Spearman Brown Coefficient for 14-item WEAR Scale for the Apple Watch was 0.87, for Google Glass was 0.88, and for the Bluetooth Headset was 0.81. These coefficients suggest that the 14-item scale has good split-half reliability. Though future development efforts may be directed at abbreviating the scale, 14 items is a reasonable length for WEAR Scale v.3. The final WEAR Scale v.3 is presented in Table 43 in order of mean loading across the three surveys.

Table 43.

Final WEAR Scale v.3*

Factors and Items	Mean Loading
Factor 1:	
9. I like what this device communicates about its wearer.	0.80
37. I could imagine aspiring to be like the wearer of such a device.	0.80
6. This device is consistent with my self-image.	0.75
45. This device would enhance the wearer's image.	0.75
46. The wearer of this device would get a positive reaction from others.	0.75
8. I like how this device shows membership to a certain social group.	0.74
7. This device seems to be useful and easy to use.	0.66
25. This device could help people.	0.55
Factor 2:	
21. This device could allow its wearer to take advantage of people. (R)	0.77
36. Use of this device raises privacy issues. (R)	0.74
17. The wearer of this device could be considered rude. (R)	0.73
30. Wearing this device could be considered inappropriate. (R)	0.72
48. People would not be offended by the wearing of this device.	0.59
33. This device would be distracting when driving. (R)	0.44

R=Reverse scored

* Likert scale: Strongly Agree (6), Agree (5), Somewhat Agree (4), Somewhat Disagree (3), Disagree (2), and Strongly Disagree (1)

6.4 Test Construct Validity of the 14-item WEAR Scale

Now that extraction and rotation demonstrated a well-performing and reliable 14-item WEAR Scale across three devices, this version was used to re-test the hypotheses that were predicted in Study 3, as well as the added hypotheses for this study. Rejection of null hypotheses provide evidence for the construct validity of the 14-item WEAR Scale.

6.4.1 Methods

These previously tested hypothesized relationships will be tested on the Apple Watch and Google Glass data:

1. A positive relationship between affinity for technology and acceptability of wearables (14-item WEAR).

2. A positive relationship between likeableness rating and social acceptability of wearables (14-item WEAR).

3. A negative relationship between age and social acceptability of wearables (14-item WEAR).

4. A positive relationship between optimism and social acceptability of wearables (14-item WEAR).

Two additional tests for validity were conducted:

5. The sum of three technology adoption questions was hypothesized to relate positively with the 14-item WEAR Scale:

- *I am eager to adopt new technology* (5-point Likert from strongly disagree to strongly agree).
- *How many wearable devices do you own (Examples: Apple Watch, Fitbit, Bluetooth headset* (*none* scored 1, *1* scored 2, *2* scored 3, *3* scored 4, and *4 or more* scored 5).
- *How long have you owned your current mobile phone?* (*less than 6 months* scored 5, *6-12 months* scored 4, *1-2 years* scored 3, *over 2 years* scored 2, and *I do not own a mobile phone* scored 1).

6. A positive relationship was hypothesized between the personality characteristics of agreeableness and intellect/imagination, and the 14-item WEAR Scale.

6.4.2 Results

Table 44 and Table 46 present the correlation matrices for the testing of the hypotheses stated above. Also shown in these tables are the correlations among the 14-item WEAR and its two components.

Table 45 and Table 47 show the hypothesized and actual relationships between the 14-item WEAR scale and the validity measures. Cronbach's alpha for Affinity for Technology was 0.92, Agreeableness was 0.76, and Intellect/Imagination was 0.74.

Table 44.

Correlations among the ten variables: Apple Watch

Measure	WEAR 14 items	WEAR C1 8 items	WEAR C2 6 items	Affinity for Technology	Likableness Rating	Age	Self-rated optimism	Adoption	Agree
WEAR - 14 items	--								
WEAR C1 – 8 items	0.88**	--							
WEAR C2 – 6 items	0.75**	0.34**	--						
Affinity for Technology	0.29**	0.29**	0.16**	--					
Likeableness Rating	0.56**	0.52**	0.38**	0.10	--				
Age	0.02	0.01	0.03	0.09	-.03	--			
Self-rated Optimism	0.33**	0.27**	0.28**	0.15**	0.19	0.05	--		
Adoption	0.37**	0.39**	0.18**	0.48**	0.21**	0.01	0.15**	--	
Agreeableness	0.19**	0.39**	0.18**	0.02	0.11	0.01	0.22**	0.07	--
Int./Imag.	0.03	0.21**	0.08	0.19**	0.01	-0.05	0.13*	0.13*	0.14*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 45.

Hypothesized and actual relationships between 14-item WEAR and validity measures: Apple Watch

Measure	Hypothesized	Actual
Affinity for technology	Positive	Positive (p<.01)
Likeableness	Positive	Positive (p<.01)
Age	Negative	Not significant (p>.05)
Optimism	Positive	Positive (p<.01)
Adoption	Positive	Positive (p<.01)
Personality	Positive	Positive (p<.05)
Agreeableness	Positive	Positive (p<.01)
Intellect/Imagination	Positive	Not significant (p>.05)

Table 46.

Correlations among the ten variables: Google Glass

Measure	WEAR 14 items	WEAR C1 8 items	WEAR C2 6 items	Affinity for Technology	Likableness Rating	Age	Self-rated optimism	Adoption	Agree
WEAR - 14 items	--								
WEAR C1 – 8 items	0.89**	--							
WEAR C2 – 6 items	0.81**	0.45**	--						
Affinity for Technology	0.27**	0.35**	0.07	--					
Likeableness Rating	0.67**	0.64**	0.49**	0.18**	--				
Age	0.04	0.02	-0.09	0.09	-0.09	--			
Self-rated Optimism	0.15*	0.12*	0.14*	0.15**	0.10	0.05	--		
Adoption	0.26**	0.36**	0.04	0.48**	0.19**	0.01	0.15**	--	
Agreeableness	0.10	0.08	0.10	0.02	0.11	-0.05	0.22**	0.07	--
Int./Imag.	-0.03	0.01	-0.07	0.20**	0.01	0.00	0.13*	-0.13*	0.14*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 47.

Hypothesized and actual relationships between 14-item WEAR and validity measures: Google Glass

Measure	Hypothesized	Actual
Affinity for technology	Positive	Positive (p<.01)
Likeableness	Positive	Positive (p<.01)
Age	Negative	Not significant (p>.05)
Optimism	Positive	Positive (p<.05)
Adoption	Positive	Positive (p<.01)
Agreeablness	Positive	Not significant (p>.05)
Intellect/Imag.	Positive	Not significant (p>.05)

Four of the hypothesized positive relationships between acceptability of wearables as measured by the 14-item WEAR Scale and related constructs (affinity for technology, likeableness, optimism, and adoption of technology) were supported in both the Apple Watch and Google Glass surveys, and the null hypotheses (that there are no such relationships) were rejected. These results strongly support the construct validity of the 14-item WEAR Scale. Additionally, the hypothesized positive relationships between acceptability of wearables as measured by the 14-item WEAR Scale, and agreeableness and intellect/imagination, were supported in the Apple Watch survey. As in Study 3, the hypothesized negative relationship between age and acceptability of wearables was not supported, which is not surprising given the limited age range of the participants.

Therefore, the final WEAR Scale v.3 (Table 43) has been shown to be valid and reliable among three devices. Next, the results and the limitations of these studies are discussed, and conclusions are presented.

CHAPTER 7

DISCUSSION AND CONCLUSION

A major finding in this research is that the datasets from three different wearables loaded onto two factors. Understanding the meaning of those two factors and how they differ is accomplished by examining the items with the highest loadings in each factor, and also by examining the key words that are present in the items in each factor, as described below. This analysis resulted in naming Factor 1 *Aspirational Desires* and Factor 2 *Social Fears*.

7.1 Factor 1: Aspirational Desires

The *Aspirational Desires* factor had two items that loaded highest at 0.80: *I like what this device communicates about its wearer* and *I could imagine aspiring to be like the wearer of such a device*. Both of these items suggest that a wearable "says something" about its wearer. This was a major theme in the literature – that worn clothing or objects are a form of communication by the wearer, directed at observers. For the wearable to be deemed socially acceptable, then, what is symbolically communicated in wearing a device must be positive, and give reason for others to aspire to be like the wearer.

Keywords and themes from the next four highest loading items in the *Aspirational Desires* factor further support this finding, in that a socially acceptable wearable: shows membership to a certain *desirable* social group; is consistent with one's self-image; is perceived as enhancing the wearer's self-image; and is expected to get a positive reaction from others. The two lowest loading items touch upon a related but distinct aspect of the device "doing good" for the user and also in the world: *this device seems to be useful and easy to use* and *this device could help people*.

All the items in the *Aspirational Desires* factor were positively worded and represent favorable aspects of wearable technology. The four highest loading items are all in the category of self-identity. Rogers (1983) identified aspiring to or desiring a greater social status as an important motivation in adopting an innovation. A novel wearable is similar to a new clothing fashion, for which the social prestige conveyed to its wearer is nearly the only benefit (Rogers, 1983). Rogers stated that status is very likely to be a major motivation for the adoption of highly visible innovations, and the emergence of *Aspirational Desires* as a factor supports this finding.

7.2 Factor 2: Social Fears

While Factor 1's items all had positive connotations, Factor 2's items all contained negative connotations. The *Social Fears* factor's highest loading item at 0.77 was: *this device could allow its wearer to take advantage of people.* Thus, a socially acceptable wearable is not a threat to other people. The next four highest loading items also contained terms that in a general sense evoke the fears and threats that the use of wearables represent. These four items reveal what a socially acceptable wearable is *not*: it does not raise privacy issues; it is not considered inappropriate; it does not cause others to perceive the wearer as rude; and it does not cause offense. The lowest-loading item on the *Social Fears* Factor, *this device would be distracting when driving*, also taps into fear-based reactions (i.e., this device could cause harm to the wearer or others).

Fear of the new was a major theme that emerged from the brief history of eyeglasses, one of the first forms of wearable technology, and was a recurring theme in the failure of Google Glass' acceptance. The second highest loading item in Factor 2 refers to a specific fear: that a device could invade one's own or others' privacy. The banning of Google Glass in places such as bars, movie theaters, and Las Vegas casinos was driven by people voicing privacy concerns (Bilton, 2015), and consumers primarily stayed away from Glass due to of privacy and safety fears (Collins, 2015). The emergence of *Social Fears* as a factor, then, is consistent with peoples' reactions historically to novel technologies, especially worn technologies, and more recently to Glass in particular.

7.3 Additional Notable Findings and Conclusion

Notably missing from these two factors are aesthetic-related items. This is surprising because 1) this was an important factor in the literature and 2) in the initial analysis of the Bluetooth dataset, the highest loading items were aesthetic related. However, in the Apple Watch and Google Glass datasets, the aesthetic factors loaded inconsistently across the four components. This suggests that aesthetics is a complex variable, and also that it may be a construct separate from social acceptability. Regardless of aesthetic appeal, a wearable will cause consternation if it disrupts social conventions and/or negatively impacts others' welfare. It is true, for example, that a device could be fashionable and stylish but also threaten privacy and be distracting when driving, thus scoring poorly in terms of social acceptability. This finding is critical for industry, which has put a tremendous focus on the aesthetic appeal of wearables, while likely underestimating the influence of symbolic communication and fear-based perceptions. Additionally, in revisiting the interview findings, the *absence* of aesthetics as a factor in social acceptability is supported. When asked what criteria are important when considering a wearable, only one participant said that fashion was important in the open-ended response. When prompted, participants answered "no" or "it depends" primarily for two reasons: 1) a wearable should not be trendy because then it will be short-lived; and 2) fashion is important to only some people, not all people.

Another surprising finding is that usefulness and ease of use are important factors in social acceptability. While not apparent in the literature, this theme was mentioned in interviews. When participants were asked what "socially acceptable" means, responses included *expect thing to be useful to community* and *unknown capabilities of device means questionable social acceptability*. When asked what criteria makes a wearable socially acceptable or unacceptable, responses included that acceptability means it benefits society and helps people, while over-functionality makes it unacceptable. Finally, in answering why people do not want devices on their own and others' bodies, lack of utility was cited as a reason. However, expert comments suggested the opposite, advising the author to avoid questions about what the device does, and stating that the item *this device seems to be useful and easy to use* is "not about the social." This highlights the importance of an unbiased approach and allowing multiple data sources (literature, interviews, expert comments) to be represented in item generation. If there are inconsistencies in the grounded qualitative data, it is not for the researcher to exclude concepts or items based on any single source, but rather to allow the best solution to emerge via scale development methodology.

While care has been taken to develop the WEAR Scale using an established and rigorous methodology, a number of limitations exist in this research. One limitation is that the participants in Studies 1, 3, and 4 were recruited from the campus of a Midwestern university. While the intended target population for the WEAR Scale is younger adults in the United States, samples drawn from diverse regions may have produced different results based on people's varying attitudes in different regions. This limits the results of the studies and also should be taken into consideration when generalizations are made about findings from future WEAR Scale administrations.

Similarly, as commented on by one of the experts, acceptability is not only culture specific but context specific, and different communities value different things. Certainly this scale developed in a different culture would yield different items. For example, in a study of the impact of a device's bodily location on social acceptability of gesture interaction, the most important criteria for a wearable in the United States was ease of operation, while in South Korea it was minimizing an awkward appearance (Profita, Clawson, Gilliland, Zeagler, Starner, Budd, & Do, 2013). Such research findings highlight the caveat that cultural differences will have an impact on both WEAR Scale development (i.e., its development in the Midwestern United States has inevitably influenced the items) and its findings (i.e., WEAR Scale results for a single wearable will differ among cultures).

Additionally, the WEAR Scale v.3 will need to show further consistent performance with additional devices to further establish its validity and usefulness. Future datasets may suggest adjustments. Subsequent studies can further evaluate validity, which is an ongoing process (Clark & Watson, 1995; Spector, 1992). If evidence continues to support validity, confidence will be gained that the WEAR Scale measures the theoretical construct – social acceptability of a wearable – that it is supposed to be measuring. Additionally, hypotheses may be formed about causes, effects, and correlates of the construct, and the WEAR Scale may be used to test these hypotheses using confirmatory factor analysis; empirical support for the hypotheses would then further validate the scale (Spector, 1992).

The WEAR Scale v.3 (Table 43), the ultimate product of this dissertation, has been shown to be a valid and reliable measure of the social acceptability of wearable devices, and opens the door to a wealth of future studies in the field of wearable computing. Because social issues in wearables development cannot be ignored (Edwards, 2003), and because the issue of “social wearability” was lacking in exploration (Dunne, Profita, Zeagler, Clawson, Gilliland, Do, and Budd, 2014), the WEAR Scale has the potential to be a consequential tool. Industry may now better understand a successful path to market and mass adoption of wearable products. Use of the WEAR Scale in research and development can help avoid bad press and navigate public expectations.

As an outcome of acceptability research, the WEAR Scale may be used to investigate the perceived attributes of an ideal wearable innovation, and guide research and development so as to create such an innovation. This will allow efforts to be focused on developing innovations that will be accepted by potential adopters, as recommended by Rogers (2003), who popularized the theory of Diffusion of Innovations. In identifying two unique dimensions of wearable social acceptability, the WEAR Scale has provided surprising and valuable information, and awaits use by both academia and industry.

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APPENDIX A
CONCEPTS FROM LITERATURE CONSDIERED IN ITEM GENERATION

Concept No. (referred to in literature review)	Reference	Concept
1	Adam & Galinsky, 2012	Wearing clothes causes people to embody not just the clothes but also the clothing's symbolic meaning. The two independent factors of enclothed cognition—the symbolic meaning of the clothes and the physical experience of wearing them—have significant and systematic psychological and behavioral consequences for their wearers.
2	Banister & Hogg, 2004	People will purposely avoid or reject a product if it is associated with negative symbolic meanings
3	Baraniuk, 2015	A wearable will have social barriers if it is: disruptive in a negative sense; annoying; disturbing to social norms; adds confusion to conventional human interaction.
4	Byrne, 1971; Davis, L.L., 1984	When we perceive others as being similar to ourselves, our own attitudes and behaviors are confirmed, and thus we are more attracted to similar others; attraction to others, or lack thereof, affects further interaction.
5	Cellan-Jones, 2015; Editorial Board, 2015; Garfinkel, 2015	"Creepy" was a recurring descriptor of Google Glass as it made its way into public consciousness. Creepy has negative connotations that range from mild (unpleasantness) to moderate (unease) to severe (fear).
6	Cunningham & Voso, 1991; see also Deutsch and Gerard, 1955; Festinger, 1954)	"Clothing helps to define our identity by supplying cues and symbols that assist us in categorizing within the culture" (p. 11).
7	Damhorst, 1984-85; Kaiser, 1997; Rees, Williams, & Giles, 1974	Clothing has been shown to be a form of nonverbal communication, with the message being dependent on the social context.
8	Davis & Lennon, 1988; Asch (1946) (inferred from)	Individuals may attribute certain causes or characteristics to the user (whether another person or themselves) based on wearing the device.

9	Davis, F., 1992	Dress can work as “a kind of visual metaphor for identity” (p. 139).
10	Davis, F.D., 1989	Davis's perceived usefulness construct may need to be restructured: is wearable's usefulness socially acceptable?
11	Davis, L.L. 1984	Appearance and clothing give rise to certain behavioral or judgmental responses in the viewer, and thus are a form of nonverbal communication.
12	Dunne, Profita, Zeagler, Clawson, Gilliland, Do, and Budd, 2014; Profita, Clawson, Gilliland, Zeagler, Starner, Budd, & Do, 2013	The qualitative analysis (2014) found that the wrist and forearm were preferred bodily placements due to reasons of usability and avoiding social discomfort. Participants expressed concerns about less favorable bodily locations for wearables as the desire to avoid feelings of awkwardness or embarrassment. The most important feature for a wearable in the United States was ease of operation, while in South Korea it was minimizing an awkward appearance.
13	Editorial Board, 2015	Google Glass did not clearly solve any problems but did pose potential risks to privacy, anonymity, and self-respect.
14	Editorial Board, 2015	Innovations require the public’s interest and consent; collectively we weigh an innovation’s benefits versus costs.
15	Entwistle, 2000	Numerous factors structure dress in the West, including fashion, sex, class, income, and tradition.
16	Entwistle, 2000	“Clothes and other bodily adornments are part of the vocabulary with which humans invent themselves, come to understand others and enter into meaningful relationships with them” (p. 182).
17	Entwistle, 2000	A person who dresses inappropriately for his or her culture is “subversive of the most basic social codes and risk[s] exclusion, scorn or ridicule.” (p. 7)
18	Entwistle, 2000	Fashion goes on the body, in public display, and is a way to fix identity, if only temporarily.
19	Fortunati, Katz & Riccini, 2003	Respect is an aspect of the body that must be kept safe, because it is closely associated with individual identity.
20	Fortunati, Katz & Riccini, 2003	Wearables are about the integration of the human body with technology, which is a topic that generates both anxiety and delight.

21	Fortunati, Katz & Riccini, 2003	The body represents the maximum level of "naturalness" possible, at a time when the artificial is extending its dominion over the natural.
22	Fortunati, Katz & Riccini, 2003	The body expresses who we are, what we have been, and who we would like to be.
23	Fortunati, Katz & Riccini, 2003	Pairing the body with technology is both exciting and threatening.
24	Gibbons & Gwynn, 1975 (inferred from)	Presumably if a wearable is consistent with a person's self image, that person will find it acceptable. If it is not, this lowers the probability of acceptance, especially for fashion-savvy individuals.
25*	Goffman, 1990	Actions may be carried out (such as wearing a device), with observers' reactions serving as feedback on the social acceptability of the action.
26	Haque, 2015	Cool is associated with social acceptability.
27	Johnson, Yoo, Kim & Lennon, 2008	Dress plays a role in the establishment of personal identities.
28	Johnson, Yoo, Kim & Lennon, 2008	Dress serves as a communication tool with others.
29	Katz, Aakhus, Kim, & Turner, 2003	Fashion is a "second skin" that projects to others how they should engage with the wearer (p. 75).
30	Lum, Sims, Chin, & Lagattut, 2009 (inferred from)	Wearables can be more impactful than clothing in the social realm in that wearables may interrupt or modify interpersonal communication as well as provide the user with capabilities like video recording.
31*	Lum, Sims, Chin, & Lagattut, 2009; Manoj & Azariah, 2001	Even though we are a technology-driven society, persons wearing technology may be perceived as less human-like, and there has been and continues to be a negative stigma attached to the excessive use of technology.
32	Lum, Sims, Chin, & Lagattuta, 2009	A wearable may make a person look threatening.
33	Lum, Sims, Chin, & Lagattuta,	Individuals may perceive others more positively when they adhere to expectations for what people naturally look like.

	2009	
34	McAtamney & Parker, 2006	A wearable may interfere with interpersonal relations.
35	Moore & Benbasat, 1991	Image, "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (p. 195), relates to social acceptability.
36	Ogle, Tyner, & Schofield-Tomschin, 2013	The choices available for a certain wearable may not allow people to express their true selves, and in fact symbolize someone they do not want to associate with.
37	Oksman & Rautiainen, 2003 (inferred from)	As technology becomes more mobile and more wearable, we will increasingly perceive it be an extension of our body, and identity.
38	Pogue, 2013	The biggest obstacles for social acceptance are the smugness of people who wear Glass and the discomfort of people who don't wear Glass.
39*	Rico & Brewster, 2010	Putting on a wearable can be viewed as a performance, "an intentional action executed by an individual with the awareness of spectators" (p. 888).
40	Rogers, 2003	Interested parties may try to speed up the innovation-decision process by sponsoring demonstrations of an innovation, which can be quite effective, especially if the demonstrator is an opinion leader.
41	Rogers, 2003	Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters, and is closely aligned with acceptability research.
42	Rogers, 2003	Complexity is the degree an innovation is perceived as relatively difficult to understand and use, and the generalization is that it is negatively related to rate of adoption.
43	Rogers, 2003	Trialability is generally positively related to rate of adoption.
44	Rogers, 2003 (inferred from)	Initial knowledge about a wearable is a factor affecting acceptability, which consequently affects the formation of attitudes toward the innovation.
45	Rogers, 2003 (inferred from)	A person's feelings and attitudes about acceptability of a wearable would be more strongly influenced by peers rather than mass media.
46	Rogers, 2003 (inferred from)	A wearable may be more socially acceptable is it displays Relative Advantage—is perceived as being better than the idea it supersedes.

47	Rogers, 2003 (inferred from)	How people perceive existing ideas in the same category of the wearable likely affects acceptability.
48	Segrave, 2011	Glasses have been perceived as disfiguring to and a social handicap for women and girls.
49	Segrave, 2011	Eyeglasses have been criticized as obtrusive, heavy, aggressive, ridiculous, and a result of inane foreign influence.
50	Segrave, 2011 (inferred from)	Some wearable technologies have forms very similar to worn objects that have been an accepted part of Western culture for decades, such as wristwatches, or centuries, such as eyeglasses.
51*	Swan, 2012	If the EEG rig were designed to be sufficiently comfortable, unobtrusive, and visually-attractive, it could be worn 24/7.
52	Taylor, Fiske, Etcoff, & Ruderman, 1978 (inferred from)	Variables that have been shown to be significant in stereotyping, such as race, sex, social status, body type, physical attractiveness, and age, may also play a role in the social acceptability of wearables; a certain wearable may display membership to a certain social group.
53	Tene & Polonetsky, 2013	Technology is creepy when it uses data in a new way or removes obscurity, but without breeching law or causing harm.
54	Tene & Polonetsky, 2013	The term "creepiness" derives from the failure of individuals and industry to adjust their actions when using new technologies, resulting in a misalignment with current social norms.
55	Tene & Polonetsky, 2013	Businesses should be open and transparent about their data practices, purposes, and needs.
56	Tene & Polonetsky, 2013 (inferred from)	The more a wearable's functions raise privacy concerns, the less socially acceptable it will be.
57*	Wasik, 2014	Phil Libin, CEO of Evernote, thinks that wearables will make human beings smarter—more aware, more mindful, less confused, and feeling part of a connected universe.
58*	Wasik, 2014	Wearables present a unique challenge: to create something beautiful and functional and personal.
59	Wasik, 2014	Robert Brunner, offered this explanation as to why technology and fashion tend to be at odds: the early adopters of technology do not necessarily provide the "aspirational dynamic" that would typically push fashion products into the mainstream (p. 99).

60	Wasik, 2014	To be fashionable, a wearable needs to convey a message the wearer is happy to send.
61	Wasik, 2014	To be fashionable, a wearable cannot be the same for and worn by "everyone."

*Cited in Chapter 1 Introduction.

APPENDIX B

IRB 15-306 LETTER OF APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 5/27/2015

To: Dr. Stephen B Gilbert
1620 Howe Hall

CC: Norene Kelly
1620 Howe Hall

From: Office for Responsible Research

Title: Development of a Scale to Measure Social Acceptability of a Wearable Device

IRB ID: 15-306

Approval Date: 5/19/2015 **Date for Continuing Review:** 5/18/2016

Submission Type: New **Review Type:** Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses,** unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX C

INTERVIEW QUESTIONS

This is a semi-structured interview. Questions may be followed up with prompts such as "and why do you feel that way?" or may be repeated and reworded slightly to allow the participant further opportunity to reflect and respond.

1. What does the term "wearable," as in wearable device or wearable computer, mean to you? Start with the top 3 words or phrases that come to mind.

2. Some examples of wearables are the Fitbit, the Apple Watch, and Google Glass. Do you own any wearables?
   If yes: Which ones?
   What has been your overall experience with the device?

3. Tell me about some wearables that you are familiar with.
   For each mentioned:
   Is your overall impression positive or negative?
   Think back to when you first encountered it. From person or media? Positive or negative first impression?

4. What are the important criteria when considering a wearable?
   Open-ended, then prompt:
   Functions?
   How it looks?
   Fashion/trendiness?
   As an expression of yourself?
   Location on the body and whether it's obvious or not?
   How you interact with it, e.g., directly or through a smartphone?

In particular, I am interested in the social acceptability of wearable devices. In other words, when people start wearing a new device like Google Glass, do other people in general find it OK? Or do other people find it objectionable? I'm interested in the factors affecting peoples' reactions to these new devices.

So I'd like to hear your thoughts on this…
5. What does "socially acceptable" mean?
6. Do you think it makes sense to talk about the social acceptability of a wearable?
7. What makes such a wearable socially acceptable or unacceptable?
8. Why do people *not* want certain devices on their own and others' bodies?

Next I will show you some pictures of wearable devices that are either actual products or prototypes of possible future products. I will also read a short description of what the device does.

SHOW IMAGE A (see below)

This is a brain sensing headband called "Muse." It is a tool that helps you do more with your mind. It is worn across the forehead, and each end goes behind the ears.

9. I wonder whether you find this device acceptable to wear in public.
Could you imagine yourself wearing it?
Imagine you saw someone in a coffee shop wearing this, how would you feel about it?

SHOW IMAGE B

This is a wearable communication device that has many of the same capabilities as a mobile phone.

10. I wonder whether you find this device acceptable to wear in public.
Could you imagine yourself wearing it?
Imagine you saw someone in a coffee shop wearing this, how would you feel about it?

SHOW IMAGE C

This is a bracelet that performs many of the same functions as a smart phone.

11. I wonder whether you find this device acceptable to wear in public.
Could you imagine yourself wearing it?
Imagine you saw someone in a coffee shop wearing this, how would you feel about it?

SHOW IMAGE D

This is a pair of augmented reality eyeglasses. They can display images and text to the wearer. They can take video and communicate with a smartphone.

12. I wonder whether you find this device acceptable to wear in public.
Could you imagine yourself wearing it?
Imagine you saw someone in a coffee shop wearing this, how would you feel about it?

To finish up the interview, I'd like to get a few more of your thoughts…

13. With a wearable innovation like the ones I've shown you, would you like to be the first of your friends to have it, or would you rather have your friends try it and tell you about it?

14. Who would make a good demonstrator of a wearable?

15. Do you think a wearable like the Apple Watch might be a fad, or could a wearable have lasting style?

16. Is it important that the wearable is an improvement over what came before?

17. Is a wearable more like a computer or an accessory?

18. Do you have any other thoughts or comments on what we have discussed?

Thank you for your participation.

Image A

http://www.cnn.com/2014/08/18/tech/can-this-brain-sensing-headband/

Image B

http://www.concept-phones.com/?s=wearable+phone

Image C

http://www.concept-phones.com/page/2/?s=wearable+phone

Image D

http://techglasses.com/sony-launches-smart-glasses-introducing-sony-smarteyeglass-sdk/

APPENDIX D

IRB 15-498 LETTER OF APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 9/11/2015

To: Dr. Stephen B Gilbert
1620 Howe Hall

CC: Norene Kelly
1620 Howe Hall

From: Office for Responsible Research

Title: Part 2 of Development of a Scale to Measure Social Acceptability of a Wearable Device: Expert Review

IRB ID: 15-498

Approval Date:	9/11/2015	**Date for Continuing Review:**	8/31/2016
Submission Type:	New	**Review Type:**	Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp**.
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX E

AFFINITY FOR TECHNOLOGY SCALE

Affinity for Technology Scale (Edison & Geissler, 2003)

Likert scale of 1-to-5 (Strongly Agree to Strongly Disagree)

1. Technology is my friend...
2. I enjoy learning new computer programs and hearing about new technologies.
3. People expect me to know about technology and I don't want to let them down.
4. If I am given an assignment that requires that I learn to use a new a new program or how to use a machine, I usually succeed.
5. I relate well to technology and machines.
6. I am comfortable learning new technologies.
7. I know how to deal with technological malfunctions or problems.
8. Solving a technological problem seems like a fun challenge.
9. I find most technology easy to learn.
10. I feel as up-to-date on technology as my peers.

APPENDIX F

WEAR SCALE V.2.1

Item	Study 3 item # (random order)	Item # following expert review revisions	Study 2 item # (expert review)	Category
I think my peers would find this device acceptable to wear.	1	43	61	Others' thoughts
The size of this device is conveniently small.	2	22	35	Ergonomics
This device is like the clothing and accessories typically worn in our society.	3	34	50	Norms
This device has a natural fit with the body and how people look. REVISED: This device looks natural and not out of place on the body.	4	24	37	Ergonomics
This device could make people uncomfortable. (Reverse scored)	5	12	20	Consequences
This device is consistent with my self-image.	6	46	70	Self-identity
This device seems to be useful and easy to use.	7	25	39	Judgment
The way this device displays membership to a certain social group is appealing. REVISED: I like how this device shows membership to a certain social group.	8	50	(new)	Self-identity
I like what this device communicates about its wearer.	9	45	69	Self-identity

Item	Study 3 item # (random order)	Item # following expert review revisions	Study 2 item # (expert review)	Category
A wearer of this device would be keeping to the social norms we need to stick to.	10	32	48	Norms
This device might be considered disfiguring to its wearer. (Reverse scored)	11	6	10	Aesthetics
This device seems creepy. (Reverse scored)	12	27	42	Judgment
This device seems like "too much" technology. (Reverse scored)	13	29	44	Judgment
This device might restrict movement or physically get in the way. (Reverse scored)	14	21	34	Ergonomics
This device is fashionable.	15	4	6	Aesthetics
This device seems comfortable, not bulky.	16	20	33	Ergonomics
The wearer of this device could be considered rude or not acting within social constraints. (Reverse scored). REVISED: The wearer of this device could be considered rude. (Reverse scored).	17	13	21	Consequences
This device symbolizes something undesirable. (Reverse scored)	18	26	41	Judgment
There has been a lot of media buzz about this device. (Reverse scored)	19	8	14	Available/Ordinary
This device is cool.	20	28	43	Judgment

Item	Study 3 item # (random order)	Item # following expert review revisions	Study 2 item # (expert review)	Category
This device could allow its wearer to take advantage of people. (Reverse scored)	21	11	19	Consequences
I can imagine that people would be interested in this device and would not have a problem wearing it.	22	33	49	Norms
This device is sleek, not clunky.	23	5	7	Aesthetics
This device seems to offer options for personalization, so that everyone is not wearing the "same thing."	24	7	11	Aesthetics
This device could help people.	25	10	18	Consequences
This device would be generally accepted by the vast majority of people.	26	38	55	Others' reactions
This device is not weird.	27	44	64	Qualities of the device or wearer
The wearer of this device would not be judged negatively by others.	28	41	59	Others' thoughts
This device is similar to existing acceptable devices or accessories.	29	9	17	Available/Ordinary
Wearing this device could be considered inappropriate. (Reverse scored)	30	35	51	Norms
This device could be considered a normal part of life.	31	31	47	Norms

Item	Study 3 item # (random order)	Item # following expert review revisions	Study 2 item # (expert review)	Category
Use of this device could be socially stigmatizing. (Reverse scored) REVISED: Use of this device could hurt the wearer's social reputation. (Reverse scored)	32	16	26	Consequences
This device would be distracting when driving. (Reverse scored)	33	14	24	Consequences
This device seems fairly common.	34	30	46	Norms
This device could cause health concerns. (Reverse scored)	35	23	36	Ergonomics
Use of this device raises privacy issues. (Reverse scored)	36	15	25	Consequences
I could imagine aspiring to be like the wearer of such a device.	37	49	73	Self-identity
There is no chance of being ridiculed when wearing this device.	38	37	53	Others' reactions
Use of this device would be more threatening than exciting. (Reverse scored)	39	19	31	Consequences
This device is stylish.	40	2	3	Aesthetics
This device's placement on the body could cause awkwardness or embarrassment. (Reverse scored)	41	18	28	Consequences
Wearing this device would elicit no reaction or a neutral reaction from other people.	42	36	52	Others' reactions

Item	Study 3 item # (random order)	Item # following expert review revisions	Study 2 item # (expert review)	Category
REVISED: Wearing this device would cause no reaction, or a neutral reaction, from other people.				
The way this device displays membership to a certain social group is unappealing. (Reverse scored) REVISED: I don't like how this device shows membership to a certain social group. (Reverse scored)	43	48	72	Self-identity
This device is goofy. (Reverse scored)	44	3	4	Aesthetics
This device would enhance the wearer's image.	45	47	71	Self-identity
The wearer of this device would get a positive reaction from others.	46	39	56	Others' reactions
This device is aesthetically pleasing.	47	1	1	Aesthetics
People would not be offended by the wearing of this device.	48	42	60	Others' thoughts
This device seems like it would be annoying or add confusion to the typical interactions of people. (Reverse scored)	49	17	27	Consequences
The majority of people probably think this device is OK to wear in public.	50	40	58	Others thoughts

APPENDIX G

IRB 15-647 LETTERS OF APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 11/23/2015

To: Dr. Stephen B Gilbert
1620 Howe Hall

CC: Norene Kelly
1620 Howe Hall

From: Office for Responsible Research

Title: Part 3 of Development of a Scale to Measure Social Acceptability of a Wearable Device: Administer Items

IRB ID: 15-647

Approval Date: 11/17/2015 **Date for Continuing Review:** 11/16/2016

Submission Type: New **Review Type:** Full Committee

-

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp**.
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing <u>any</u> changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 3/3/2016

To: Dr. Stephen B Gilbert
1620 Howe Hall

CC: Norene Kelly
1620 Howe Hall

From: Office for Responsible Research

Title: Part 3 of Development of a Scale to Measure Social Acceptability of a Wearable Device: Administer Items

IRB ID: 15-647

Approval Date: 3/1/2016 **Date for Continuing Review:** 11/16/2016

Submission Type: Modification **Review Type:** Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

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Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 3/18/2016

To: Dr. Stephen B Gilbert
1620 Howe Hall

CC: Norene Kelly
1620 Howe Hall

From: Office for Responsible Research

Title: Part 4 of Development of a Scale to Measure Social Acceptability of a Wearable Device: Administer Items

IRB ID: 15-647

Approval Date: 3/15/2016 **Date for Continuing Review:** 11/16/2016

Submission Type: Modification **Review Type:** Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
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